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THE PROCEEDINGS

of the

Institute of Medicine of Chicago

Vol. 3 No. 4

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CHICAGO
1921

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THE PROCEEDINGS

of the

Institute of Medicine of Chicago

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1920-21

CHICAGO
1921

OFFICERS

	1920	1921
PRESIDENT	Thomas L. Gilmer	George H. Simmons
VICE-PRESIDENT	D. J. Davis	C. Judson Herrick
SECRETARY	J. Gordon Wilson	E. E. Irons
TREASURER	J. A. Capps	J. A. Capps

BOARD OF GOVERNORS

L. Hektoen, Chairman	L. Hektoen, Chairman
Frank Billings	Frank Billings
Joseph A. Capps	Joseph Capps
W. T. Belfield	W. T. Belfield
C. D. Wescott	C. D. Wescott
W. A. Pusey	W. A. Pusey
Dean D. Lewis	Dean Lewis
J. Stieglitz	J. Stieglitz
E. J. Doering	E. J. Doering
C. A. Elliott	C. A. Elliott
Jas. B. Herrick	James B. Herrick
N. S. Davis	D. J. Davis
Robert B. Preble	S. J. Walker
Thomas J. Watkins	A. I. Kendall
Frank Cary	J. Gordon Wilson

FELLOWS

Abbott, Don P.
Abt, Isaac Arthur
Adler, Herman M.
Alexander, Wm. G.
Andrews, Edmund
Andrews, Edward Wyllys
Andrews, Frank Taylor

Babcock, Robert Hall
Bacon, Charles Sumner
Baer, Jos. L.
Barnes, Walter S.
Bassoe, Peter
Baum, William L.
Baxter, George Edwin
Becht, Frank C.
Belfield, William Thomas
Bensley, Robert Russell
Bevan, Aurthur Dean
Billings, Frank
Black, Arthur D.
Black, Robert A.
Blatchford, Frank W.
Bloch, Leon
Blue, Robert
Brawley, Frank
Brenneman, Joseph
Bridge, Norman
Brown, Edward Vail Lapham
Brown, Ralph C.
Brown, Sanger
Buford, Coleman Graves
Burmeister, Wm. H.

Capps, Joseph Almarin
Carlson, Anton Julius
Cary, Eugene
Cary, Frank
Cheney, Henry William
Child, Charles Manning
Church, Archibald
Clark, Wendell J.
Coleman, Geo. H.
Colwell, Nathan Porter
Crowder, Thomas R.
Culver, Harry
Curtis, Arthur Hale

Dagg, Thomas L.
Danforth, William Clark
*David, Frank E.
David, Vernon C.
*Davis, Achilles
Davis, Carl Braden
Davis, David John
Davis, Geo. G.
*Davis, Nathan Smith
Davis, Nathan Smith III
Davison, Chas. A.
DeLee, Joseph Bolivar
Dick, George Frederick
Dodd, Oscar
Dodson, John Milton
Doering, Edward James

Eisendrath, Dan'l N.
Elliott, Arthur R.
Elliott, Charles Addison
Ellis, John Bernard
Falls, Frederick H.
*Favill, Henry Baird
Favill, John
Fishbein, Morris
Frank, Ira
Frankenthal, Lester Emanuel
Frick, Anders
*Friedberg, Stanton Abeles
Friedman, Joseph C.
Frothingham, Herbert H.
Futterer, Gustav

Gamble, William Elliot
Gardiner, Edwin J.
Gatewood, Lee C.
Gay, Robert J.
Gentles, Harry Wernieke
Gerstley, Jesse Robert
Gethro, Fred W.
Gill, James Cornelius
Gilmer, Thomas Lewis
*Gilmore, Robert Tracy
Goodkind, Maurice L.
Green, George Willard
Greer, Jas. R.
Grulee, Clifford Groselle

Haines, Walter Stanley
Hall, George Washington
Halstead, Albert Edward
Hamburger, Walter Wile
Hamill, Ralph C.
Hamilton, Alice
Harkins, Wm. Draper
*Harris, Frederick Gillette

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*Deceased

FELLOWS—Continued

Harris, Malcolm La Salle
Harsha, William McIntyre
Harvey, Basil Coleman Hyatt
Hatton, Edw. H.
Heaney, Noble Sproat
Hektoen, Ludvig
Henderson, Elmer E.
Herbst, Robert H.
Herrick, Charles Judson
Herrick, James Bryan
Hess, Julius H.
Hessert, William
Hoelscher, Julius H.
Holinger, Jacques
Holmes, Rudolph Wieser
Howell, Katharine M.

*Ingalls, Ephraim Fletcher
Irons, Ernest Edward

Jones, Harold E
Jordan, Edwin Oakes

Kampmeier, Otto F.
Kanavel, Allen Buckner
Kendall, Arthur I.
Kerr, Ellis Kirk
Koch, Fred Conrad
Koessler, Karl Konrad
Kretschmer, Herman Lewis
Kuh, Sidney

Lane, Francis Adonijah
LeCount, Edwin Raymond
Levison, Abraham
Lewis, Dean De Witt
Lewis, Thomas Henry
Lieberthal, David
Lillie, Frank Rattray
Loeb, Ludwig Mannheimer
*Long, John H.
Loring, J. Brown
Lounsberry, Benj. F.
Luckhardt, Albert E.

MacKechnie, Hugh N.
Matthews, Sam'l A.
Mayers, Lawrence H.
Marquis, George Paul
McArthur, Lewis Linn
McArthur, Selim W.
McCoy, Herbert N.
McGuigan, Hugh
McKenna, Hugh C.
Menge, Frederick
Miller, Joseph Leggett
Mix, Charles Louis
Mock, Harry Edgar
Moorehead, Frederick Brown
Moore, Josiah J.

Nadler, Walter H.
Nicoll, Homer King
Norcross, Edward Powers
Norton, John Foote
Noyes, Frederick B.

Ochsner, Albert John
Ormsby, Oliver Samuel
Osgood, Luther J.

Paddock, Charles Evart
Parmelee, Arthur H.
Parkes, William Ross
Patrick, Hugh Talbot
Peterson, Wm. F.
Phemister, Dallas Burton
Pierce, Norval Harvey
Pietrowicz, Stephen Roman
Plummer, Samuel Craig
Pollock, Louis J.
Porter, John Lincoln
Portis, Milton Moses
Post, Wilber E.
Potter, Hollis Elmer
Potts, Herbert Anthony
Preble, Robert Bruce
Pusey, Brown
Pusey, William Allen

Quine, William Edward

Ransom, S. W.
Raulston, Burrell O.
Reed, Charles Bert
Reed, Dudley B.
Rhodes, John Edwin
Richter, Harry Mortimer
Ries, Emil
Rothstein, Thor
Ryerson, Edwin Warner

*Sachs, Theodore B.
Sauer, Lewis W.
Saurenhaus, Ernst
Schmidt, Louis Ernst
Schmidt, Otto L.
Sceleth, Charles E.
Shambaugh, George Elmer
Simmons, George H.
Simonds, James P.
Simpson, Elmer E.
Simpson, Frank Edward
Singer, H. Douglas
Sippy, Bertram Welton
Slaymaker, Samuel Robert
Small, Arthur Atwell
Spalding, Heman
Speed, Kellogg
Stevenson, Alexander Francis
Stieglitz, Julius

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*Deceased

FELLOWS—Continued

Stillians, Arthur Wm.
Storey, Chas. A.
Swan, Chas. J.
Strouse, Solomon

Tarnowsky, George de
Theobald, Walter
Tice, Frederick
Tieken, Theodore
Tunnicliff, Ruth

Vaughan, Roger Throop
Volini, Camillo

Walker, Samuel Johnson
Washburn, James Murray
Watkins, Thomas James
Weaver, George Howitt
Webster, George W.
Webster, Ralph Waldo
Welker, Wm. H.
Wells, Edward Franklin
Wells, Harry Gideon
Wescott, Cassius D.
Wilder, William Hamlin
Willard, William G.
Williamson, Charles Spencer
Wilson, John Gordon
Woley, Harry P.
Woodyatt, Rollin Turner
Wright, Frank

HONORARY FELLOWS

Frothingham, J. T.
Lusk, Graham
Smith, Theobald
Vaughan, Victor

NON-RESIDENT FELLOWS

Austin, Richard S.
Davis, Benj. F.
Doane, Philip P. S.
Dewey, Richard
Gaarde, F. W.
Harvey, James Alexander
Hoskins, R. G.
Helmholtz, Henry F.
Johnson, Frank
Mathews, Albert Prescott
Moody, Albert M.
Woodruff, Thomas A.
Webster, J. Clarence

CONSTITUT ON AND BY-LAWS
OF THE
INSTITUTE OF MEDICINE
OF CHICAGO

CONSTITUTION

ARTICLE I.
NAME.

The name of this Association shall be the Institute of Medicine of Chicago.

ARTICLE II.
OBJECTS.

The objects of this Institute shall be to promote the study and to encourage the advancement of medicine and allied sciences.

ARTICLE III.
MEMBERSHIP.

SECTION 1. The membership of this Institute shall consist of Fellows, Associates, Honorary Fellows, Life Fellows, and Benefactors. Only the Fellows and Life Fellows and Benefactors shall be eligible for office or have the right to vote. In the event of dissolution of the Association the assets thereof shall be distributed only among the Fellows, Life Fellows and Benefactors, pro rata according to payments made.

SEC. 2. Fellows shall be physicians who are graduates of at least five years' standing of medical schools, or persons engaged in allied scientific pursuits.

SEC. 3. Associates shall be physicians who have been graduates of at least five years' standing of medical schools, and who do not reside within fifty miles of the center of Chicago, or persons engaged in scientific pursuits allied to medicine who do not live within fifty miles of the center of Chicago. In addition, physicians and other persons engaged in scientific pursuits allied to medicine, living within the above prescribed limits, whose income is derived from teaching, or research, or like pursuits, and who, in the judgment of the Board of Governors, are, because of their limited income, entitled to especial consideration in respect of dues, may be elected Associates.

SEC. 4. Honorary Fellows shall be physicians or scientists of distinction.

SEC. 5. Any Fellow of the Institute may upon the payment of $1,000 become a Life Fellow.

SEC. 6. Benefactors shall be persons who have rendered illustrious service, or notable aid to the Institute. They shall be exempt from the payment of dues, but shall be subject in all other respects to the obligations, and shall possess all of the privileges of Fellows.

ARTICLE IV.
BOARD OF GOVERNORS.

SECTION 1. The corporate powers of the Institute shall be vested in a Board of Trustees, called a Board of Governors, fifteen (15) in number, of whom three (3) shall be elected each year. The term of office of each Governor, except the first Governors elected, shall be five (5) years, or until his successor is elected.

SEC. 2. Of the first Governors elected, three (3) shall serve until the first annual meeting; three (3) until the second annual meeting; three (3) until the third annual meeting; three (3) until the fourth annual meeting and three (3) until the fifth annual meeting.

SEC. 3. Any vacancy occurring in the Board from any cause except the expiration of the term of office shall be filled by the Board of Governors, but only for the period between the time of occurrence of the vacancy and the next annual meeting, at which meeting a Governor shall be nominated and chosen to fill out such unexpired term.

SEC. 4. The Board of Governors shall elect all officers and appoint all standing committees of the Institute in accordance with the provisions of Article V of the Constitution; shall have the management and care of all funds and property of the Institute; shall, after proper nomination, elect all Fellows, Associates, Honorary Fellows, Life Fellows, or Benefactors; shall have the power of discipline provided in Article VII; shall manage all of the affairs and business of the Institute either directly or through such officers or agents as it may see fit to authorize.

ARTICLE V.

OFFICERS.

SECTION 1. The officers of the Institute shall be President, Vice-President, Chairman of Board of Governors, Secretary, Treasurer.

SEC. 2. The President shall be elected by a majority vote of the entire Board of Governors, either from their own number or from the Fellowship body, for a period of one year, and may be re-elected only once.

SEC. 3. The Vice-President shall be elected in the same manner as the President, and may be re-elected only once.

SEC. 4. The Chairman of the Board shall be elected by a majority vote of the Board of Governors from their own number for a period of one year.

SEC. 5. The secretary shall be elected by a majority vote of the Board of Governors, either from their own number or from the Fellowship body, for a period of one year.

In the event of the election of the Secretary from the Fellowship body and not from the Board of Governors, he shall have the voting privileges of a Governor.

SEC. 6. The Treasurer shall be elected by a majority vote of the Board of Governors from their own number for a period of one year.

SEC. 7. In the event of the election of the President from the Fellowship body and not from the Board of Governors, he shall have the right to sit with the Board in all its meetings and shall vote as a Governor. The Vice-President shall have the same right in the absence of the President.

ARTICLE VI.

ELECTION OF MEMBERS.

SECTION 1. Election of Fellows, Associates, Honorary Fellows, Life Fellows or Benefactors shall be by the Board of Governors at any regular or special meeting of the board.

SEC. 2. Election shall be by secret ballot, and three negative votes shall be sufficient to reject the candidate.

ARTICLE VII.

DISCIPLINE.

SECTION 1. The Board of Governors may censure, or suspend, or drop, or expel any member for cause.

SEC. 2. No action for discipline against a member shall be taken before giving the accused a notice of at least one week before the impending action, and an opportunity to appear before the Board and present evidence in his own behalf.

A vote of three-fourths of the Governors present (and in no event less than eight (8) Governors) shall be necessary to censure, or suspend, or drop, or expel, a member. Such action may be taken only at a meeting of the Board regularly called in accordance with the By-Laws.

ARTICLE VIII.

AMENDMENT.

The articles of this Constitution may be amended only at an annual meeting by an affirmative vote of three-fifths of the Fellows of the Institute.

Amendments may be proposed by any member entitled to vote. Notice of a proposed amendment must be presented at a regular or special meeting of the Institute at least one month before the date when final action thereon is to be taken, and must then be referred to the Board of Governors. The Board shall then send a printed copy of the proposed amendment to each Fellow at his last given address, and shall also have the same printed on the announcement of the meeting at which the vote is to be taken.

BY-LAWS

ARTICLE I.

MEETINGS.

SECTION 1. The annual meeting of the Institute shall be held on the first Tuesday in December in each year. At least fifteen (15) days, and not more than thirty (30) days, prior to such meeting the Secretary shall mail to each Fellow, at his last known address, a notice setting forth the time and place, when and where such meeting is to be held. At each annual meeting of the Institute, three (3) members of the Board of Governors shall be elected; the officers of the Institute shall make full reports of all matters pertaining to the respective officers, showing the particulars of the work of the Institute during the year, and showing, as nearly as posible, the condition of the Institute at the time of such meeting; and such other business may be transacted as may be legally brought before the meeting for its action.

SEC. 2. A special meeting of the Institute may be called at any time by five (5) Governors, by filing with the Chairman a written call, stating the object of the desired meeting, or by the Chairman of his own motion. Immediately upon the filing of such written call, or upon his own motion, the Chairman shall direct the Secretary to mail, and the Secretary shall mail to each Fellow, at his last known address, a notice of such special meeting stating the place and time thereof which place and time shall be fixed by the secretary, the time to be not less than ten (10) nor more than twenty (20) days from the date of the mailing of such notice, and also stating the object for which such meeting is called. No business not germane to the special object mentioned in such call shall be transacted at such special meeting.

SEC. 3. A quorum shall be deemed to be present at any meeting of the Institute when twenty (20) or more members entitled to vote are present.

SEC. 4. Any meeting of the Institute at which less than a quorum is present, may be adjourned my those present from time to time until a quorum shall be obtained, and it shall not be necessary to give notice of such adjournment to any of the members.

SEC. 5. The annual meeting of the Board of Governors shall be held within eight (8) days after the adjournment of each annual meeting of the Institute, at which meeting of the Board the officers for the ensuing year shall be elected and such other business shall be done as may properly come before such a meeting.

SEC. 6. Special meetings of the Board of Governors may be held on not less than three (3) days' notice of the time and place thereof, given to each Governor in person or by mail. Such notice may be given by the Chairman or shall be given by the Secretary when requested by the Chairman or when thereunto requested by five (5) members of the Board of Governors.

SEC. 7. A majority of the Board of Governors shall constitute a quorum for the transaction of business at any meeting of the Board duly called.

SEC. 8. Any meeting of the Board of Governors at which less than a quorum is present may be adjourned by those present from time to time until a quorum shall be obtained and it shall not be necesary to give notice of such adjournment to any of the Governors.

SEC. 9. Notice shall not be necessary to the validity of any meeting of the Institute at which all the Fellows are present. Nor shall any notice be necessary to the validity of any Governors' meeting at which all Governors are present. When a quorum has not been present at a meeting of the Board of Governors, the actions of the meeting shall be valid even though notice thereof has been given, if the Governors not present shall, in writing, on the margin of the record of such meeting, waive notice thereof.

SEC. 10. Any meeting of the Institute and any of the Board of Governors after having duly convened and having proceeded to business, may be adjourned from day to day; and it shall not be necessary to give notice of such adjournment to any member or Governor whatsoever.

ARTICLE II.

DUTIES OF OFFICERS.

SECTION 1. The duties of the President shall be to preside at the meetings of the Institute. At the annual meeting next after his election he shall deliver an address.

SEC. 2. The Vice-President shall discharge the duties of the President when the President is absent or unable to act.

SEC. 3. The Chairman of the Board of Governors shall preside at the meetings of the Board.

He shall exercise a general supervision over the affairs and the business of the corporation, and shall execute in the name of the Corporation (having been first thereunto authorized by the Board of Governors) all deeds, bonds and other contracts of the Corporation.

The Board may delegate to the Chairman all its powers, provided, however, that it may not delegate to him its power to elect members of the Institute or the Board, and provided further that it may not delegate to him the power of expending money or disposing of any property of the Institute without the previous regularly authorized approval of the Board.

He shall have authority to call meetings of the Board on his own motion, and must call them upon written request signed by five members of the Board or twenty Fellows.

SEC. 4. The duties of the Secretary shall be as follows: He shall be custodian of the seal of the Institute and shall attest the same whenever used; he shall cause full and acurate records of all meetings of the Institute and of the Board of Governors to be transcribed into the Record Book of the Institute over his signature; he shall give due notice of all meetings of the Institute and of the Board of Governors; he shall join the Chairman in executing all deeds, bonds and other contracts of the Institute and shall affix the seal of the Institute to all such instruments and shall safely keep all books, documents and papers of the Institute other than those relating to its fiscal affairs.

SEC. 5. The duties of the Treasurer shall be as follows: He shall receive and receipt for all funds of the Institute and shall deposit them in the name and to the credit of the Institute in such bank or banks as the Board of Governors may designate, or in the absence of such designation, as he may think proper; he shall sign, in the name of the Institute, all checks and drafts upon the bank account or bank accounts of the Institute *provided* that the Board of Governors by resolution may direct all checks or drafts of the Institute to be countersigned by some officer of the Institute to be appointed by the Board of Governors in addition to the Treasurer; he shall, out of the funds of the Institute, make such payments, and only such as shall first have received the approval of the Board of Governors, or of some person or persons authorized by the Board of Governors to give such approval; he shall make no payments except upon proper vouchers and he shall cause all vouchers for payments by him out of the funds of the Institute to be properly filed and preserved; he shall cause full and complete books of account of the business of the Institute to be kept in proper form so that the financial condition of the Institute may at all times be readily ascertained therefrom. He shall give a bond which shall be approved by the Board of Governors, and his accounts shall be audited annually by an auditor or accountant designated by the Board.

ARTICLE III.

MEMBERS.

SECTION 1. The Board of Governors may fix from time to time the number of Fellows, Honorary Fellows, Life Fellows, Associates, and Benefactors.

Candidates whose names have been favorably acted upon by the Board of Governors shall become members of the Institute only after they shall have complied with all the conditions of membership, including the payment of the admission fee. The election of any candidate shall be void if he fails to pay his admission fee, or to comply with the other requirements of admission within thirty (30) days after notice of election is mailed, addressed to him at the place given as his residence on his proposal for membership.

Each candidate for membership of any character shall be proposed by a Fellow, and the proposal shall be seconded by two (2) Fellows of the Institute. The proposal shall be upon a printed form of the Institute, and shall be accompanied by such information from the proposers as will enable the Board of Governors to judge satisfactorily as to the fitness of the candidate, the form of such application to be determined by the Board of Governors.

SEC. 2. The Board of Governors may make such rules for its government in passing upon candidates as it sees fit, provided, however, that only such candidates as have been acted upon by the Committee on Membership shall be presented to the Board for election, and provided that three negative votes shall be sufficient to reject a candidate.

SEC. 3. No candidate who has been rejected shall again be proposed within twelve months following the date of such rejection.

SEC. 4. Every original and every new Fellow and all Associates shall sign the Constitution and By-Laws of the Institute in token of his or her assent and agreement to be bound by the Constitution and By-Laws, which shall at all times constitute a binding contract between the members so signing.

SEC. 5. Every member on election to and completion of membership shall be entitled to a copy of the Constitution and By-Laws of the Institute.

SEC. 6. Any member who has complied with the Constitution and By-Laws may resign his membership by presenting a communication to that effect to the Board of Governors, but no resignation shall be valid until acted on by the Board. No resignation of any member shall be accepted while his dues are in arrears.

SEC. 7. Any Fellow moving his residence to a point more than fifty (50) miles from the center of Chicago shall be entitled to change his Fellowship and become an Associate on a written application for such change to the Board of Governors.

Fellows and Associates removing to a distance greater than 100 miles from Chicago, may, upon vote of the Board of Governors, be carried on the roll as Fellows, and receive all notices of meetings and copies of transactions.

They shall be exempt from the payment of all dues. In event of dissolution of the Association, they shall not share in the distribution of the assets.

ARTICLE IV.

ELECTION OF GOVERNORS

SECTION 1. At least thirty (30) days previous to the annual meeting, the Board of Governors shall nominate three (3) Fellows for positions on the Board, to be voted on at the annual meeting of the Institute, and shall announce such nomination by a printed notice to all the Fellows.

SEC. 2. The Secretary shall cause the names of all the nominees to be printed on a single slip or ballot, one copy of which, with a copy of this By-Law, shall be mailed to each Fellow with the notice of the election and of the annual meeting.

SEC. 3. Other nominations for these positions may be made by application of fifteen (15) Fellows to the Board of Govenors at least ten (10) days before the date of annual election. If such other nominations shall be made the Secretary shall mail to each Fellow a new ballot showing the names of all nominees, and also showing which nominees are those proposed by the Board.

SEC. 4. The election shall be by ballot deposited in person between the hours of 7 : 00 and 9 : 00 p. m., under the direction of three (3) tellers previously appointed by the Board of Governors, and the three (3) candidates receiving the greatest number of votes shall be deemed elected as Governors.

SEC. 5. No Fellow who is in arrears or whose dues have not been paid, and no Fellow, Life Fellow or Benefactor who is under suspension, shall be entitled to vote or be eligible for office.

ARTICLE V.

COMMITTEES.

The Board of Governors may appoint such standing and special committees and delegate to any of them such of its powers as it sees fit. It shall appoint from its own members a Committee on Membership of five (5). The Committee on Membership shall have power to propose members on its own motion as well as to pass upon candidates proposed by the Fellows. A majority vote of the Committe on Membership shall be necessary to act upon a candidate. Membership in all of these Committees shall expire at the next succeeding annual meeting of the Board of Governors.

ARTICLE VI.

FEES AND DUES

SECTION 1. The admission fee for Fellows shall be $100.

SEC. 2. The admission fee for Associates shall be $50.

SEC. 3. The annual dues of Fellows shall be $25.

SEC. 4. The annual dues of Associates shall be $10.

SEC. 5. No one can become a Fellow or Associate until the corresponding admission fee is paid.

SEC. 6. If the dues of any Fellow remain unpaid for a period of three months after the beginning of the fiscal year, notice shall be sent to such member that if such default continues an additional nine months, he will be dropped from membership. If said dues are not paid within the fiscal year, said Fellow shall be droped from membership without further action on the part of the Board, and can only be reinstated by the payment of back dues and special vote of the Board.

ARTICLE VII.

MEMBERSHIP.

SECTION 1. Physicians or persons engaged in scientific pursuits allied to medicine who are engaged in teaching or research, or like pursuits, and whose income is derived from such pursuits, and who, in the estimation of the Board of Governors, are entitled to this especial consideration, may become Fellows upon the payment of an admission fee of $25. and shall pay annual dues of $5.

SEC. 2. Honorary Fellows, Life Fellows and Benefactors shall be exempt from admission fees and from the payment of annual dues, but they shall be subject in all other respects to the obligations and shall possess all the privileges of Associates. Life Fellows and Benefactors shall have the same rights and privileges in all respects as Fellows.

SEC. 3. Any member of the Institute who under the special provisions of this Article has entered the Institute with an admission fee less than that of Fellows and who has paid dues less than those of Fellows, shall become a Fellow when the conditions of these special provisions cease to exist and thereupon shall pay an extra admission fee equal to the difference between the admission fee which he originally paid and that prescribed for Fellows, and thereafter shall pay the annual dues of Fellows. The Board of Governors may direct any such members to qualify as a Fellow when in its judgment the conditions of said special provisions are no longer applicable to said member.

SEC. 4. Any member of the Institute who shall have reached the age of 70 years, and shall have been a member continuously since its organization, or for a period of 25 years, shall have all the privileges of the membership which he therefore enjoyed, but shall be exempt from the payment of dues.

ARTICLE VIII.

AMENDMENTS

These By-Laws, or any of them, may, at any annual meeting or adjourned annual meeting and not otherwise, be altered, amended, or repealed by the affirmative vote of at least two-thirds in number of the Fellows present at the meeting.

Notice of a proposed amendment must be presented at a regular or special meeting of the Institute at least one (1) month before date when final action thereon is to be taken, and must then be referred to the Board of Governors. The Board shall then send a printed copy of the proposed amendment to each Fellow at his last given address and shall also have the same printed on the announcement of the meeting at which the vote is to be taken.

ARTICLE IX.

THE CORPORATE SEAL OF THE INSTITUTE.

The corporate seal of the Institute shall be a die in circular form upon which shall apear the following words: Institute of Medicine of Chicago—Corporate Seal.

SPIRIT BELIEF IN SCIENTIFIC GARB

JOSEPH JASTROW
University of Wisconsin
March 25, 1921

The belief in the action of spirit agencies is associated on the historical side with the foundation of modern spiritualism in the United States in 1848. This in turn is but a revival of an ancient belief which chanced to have a large following both in Europe and in this country. One source of the belief in spirit agencies arises from the folk-lore tradition which was responsible for the particular form which the manifestations assumed in the hands of the Fox children in 1848. While this historical aspect of the narrative must be considered, it is the main purpose to follow the attempt to support such beliefs by scientific evidence. Even as early as 1855 a scientific sponsor appeared in the person of Professor. Robert Hare, who devised an apparatus by which the medium recorded messages through an indicator moving across an alphabet. The excitement of the movement brought forward from Faraday in England a device which showed that the moving of the table by way of raps and pushes was due to the involuntary efforts of the sitters. This little apparatus was actually used as a means of extending the cult, for this is the real origin of the "planchette."

The same well-known psychologic principle was set forth by Chevreuil in France, who referred the table-moving to the same force as moves the divining rod. So from the outset men of science have been prepared to leave their work to meet a public demand for a rational explanation of phenomena exciting public interest. But the testimony of the few scientific men who were prepared to believe in supernatural agencies had an enormous influence in spreading the belief in spirits. This is true particularly of the investigation of Sir William Crookes, and of the adherence of Alfred Russel Wallace to this belief

As spiritualism continued, new forms of manifestation were advanced, and from time to time men of science were called on to render a verdict as to their "validity," the usual alternative being that of supernormal or fraud. But the entire aspect of the problem was changed in 1882 by the foundation of the Society for Psychical Research, which attempted from the outset to undertake a strictly scientific investigation of all such phenomena. This approach changed the emphasis from a belief in spirit agency to a possibility of the command of supernormal powers by specially endowed persons. The early adherence of this Society to the theory of "telepathy" set the current in the direction of all types of supernormal and occult beliefs. An important event was the report of the Seybert Commission in 1888. They examined a group of prominent spiritualist mediums in America, and without exception found all the manifestations due to gross fraud. It was probably through the influence of this report that the Fox sisters publicly confessed in 1888 that their raps, forty years earlier, had been produced by natural means.

Meanwhile a number of adherents to a belief in some form of supernormal agency had appeared, as shown in the writings of such men as Lodge, Richet, Lombroso, Flammarion, and others. While these accessions continued the possibility of maintaining a status for the supernormal, it can safely be said that the more recent studies have had the widest effect.

The main purpose of the present survey is accordingly to investigate the nature of the most recent evidence. It would be proper to begin with the investigation of Paladino which culminated in 1910 in the detailed exposure of her methods. While there was nothing novel or notable in her performances, it may safely be said that no one had accumulated such a large number of scientific sponsors for the "genuineness" of her mediumship. This alone accounted for her reputation. Her central performance consisted merely in "levitating" a table under conditions which presumably excluded fraud. It is this same phenomenon that in 1915 to 1918 was the subject of three books by Dr. Crawford of Belfast, Ireland. As an engineer, he explains the levitation by the principle of a "psychic cantilever." His books are full of tables and diagrams, pictures of apparatus and measurements, and therefore carry the air of scientific demonstration. When closely examined it appears that he is so convinced in advance that fraud is excluded that he gives this alternative the barest consideration, and is blind to the most obvious indications of natural (but fraudulent) operations. It is equally clear that his credulity increases as the investigations go on.

The largest center of the present interest in the occult is in Paris. There a considerable group of men are active in investigation and formulation, evidently prepossessed with occult ideas of spirit agencies. They have put forth elaborate theories centering about the phenomena of "materialization." They have founded an institution for such studies, the president of which is Dr. Geley. The most elaborate publication is the book of Schrenk-Notzing, in German, and of Madam Bisson in French. The English translation from the German volume has recently appeared with additional material, and has precipitated a lively discussion. The evidence is minutely photographic, and presents the appearance of gauzy substances emerging from the mouth of the medium, and the further appearance of flat-like forms, which are disclosed behind a curtain under the control of the medium. The evidence rests, as in all such cases, on the exclusion of fraud; and this is totally unsatisfactory to a critical inquiry. The common feature in all such beliefs is the increasing credulity of the investigator, and their willingness to entertain theories which are extravagant to the degree of being pathologic.

While it is essential to the statement of the problem of spirit belief to understand the circumstances, historical and otherwise, under which such beliefs have arisen and have been promulgated, the fundamental interest lies in the nature of the mental processes concerned. It seems at first sight incredible that men trained to scientific thinking should be willing to conduct experiments which from the outset disregard the simplest scientific precautions. To the psychologist there can be only one interpretation; that of intense prepossession, however concealed, however subtle, however slight, and however much associated with clear, logical powers in other directions. The hypothesis of "logic tight compartments" or "reserved areas of conviction" seems necessary to explain the strange mingling of scientific argument and mathematical formula and observation after exact methods (which none-the-less violate the most elementary precautions against fraud) with a definite set toward an occult conclusion. The internal evidence of such an abnormal type of thinking is rarely absent. The hypothesis of the emergence from the body of the medium of a substance called "ectoplasm," which in turn is reabsorbed into the body of the medium at the close of the performance, is maintained as necessary, and to the authors plausible; and for no other reason than that they reject all other ways to account for the appearance presented. The total improbability of such an hypothesis seems hardly realized; it is easy to find collateral evidence that a mind capable of tolerating such an hypothesis (not to say cherishing and embracing) is also affected by attitudes of credulity and presuppositions of an unusual character. From the logical point of view, the fundamental interest lies in the alternative between fraud and extravagant hypotheses of this order. Naturally the demand arises for the precise explanation of the appearances, nor has this obligation been shirked. The astounding documents of Dr. Schrenck-Notzing have been critically examined; it has been made clear that the true explanation of the gauzy substances lies in the fact that the medium is a regurgitant. The "matenalized" substances are swallowed and brought up again as needed. The other "human form" flat phenomena are doubtless smuggled in when precautions are relaxed. However legitimate the demand for a concrete explanation, such a requirement can hardly be met when one considers the lack of control of conditions, and the fundamental fact that in all such performances the medium completely controls the time and manner of appearance. The very nature of a scientific experiment is that such control shall rest in the hands of the experimenter. The interest in the particular modes by which phenomena have been produced, which apparently suggest to those thus inclined to credit supernatural powers is, however, quite secondary to the psychologic problem of the attraction inherent in occult beliefs. It would appear that the "occult" must be accepted as a distinctive form of thinking which gives a peculiar satisfaction; in these days men recognize the need of a scientific sanction and thus invade the domain of science to find the support of scientific evidence. It is a tribute to the widespread authority of science that in the laboratory alone is it supposed that a convincing proof can be found. But what is actually presented is a travesty of science, a medley of a superficial scientific adherence associated with a fundamental unscientific credulity. It is as a remarkable example of such eccentric beliefs that the subject merits attention. It does so in addition through the historical fact that for one mind seeking proofs for this order, there are hundreds ready to accept the welcome conclusions on a totally different type of evidence. The fact that spiritualists and others committed to a belief in the occult look to the sponsors of so-called scientific experiment, places a responsibility on the true representatives of science to counteract such pernicious influences.

THE ETIOLOGY OF YELLOW FEVER

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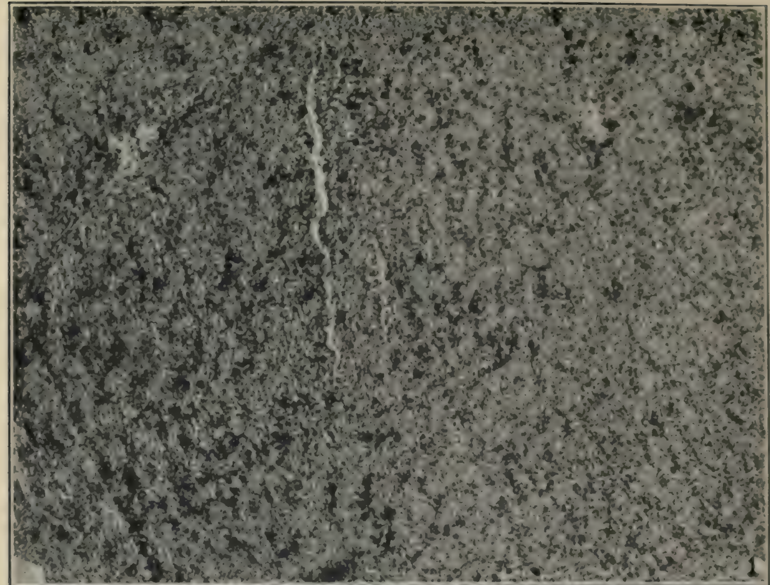
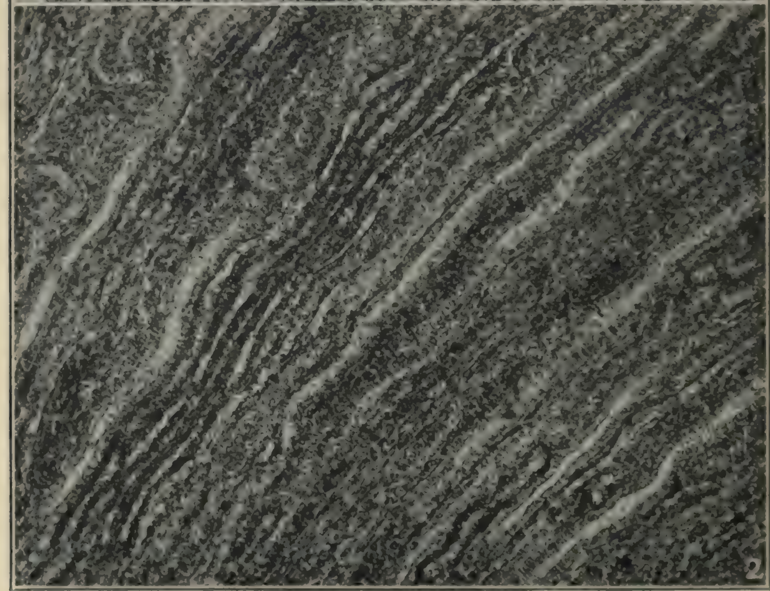
The infectious nature of yellow fever was recognized by observers of the early eighteenth century, but the manner of its spread was not understood. Nott suspected mosquito transmission, and Finlay advanced the theory that Stegomyia fasciata was the mosquito which carried yellow fever from man to man. Finlay believed that a mosquito which had sucked the blood of a yellow fever patient was capable of transmitting the disease at once. Carter pointed out that there was always a period of about two weeks between the appearance of the first cases and the development of the secondary cases. This finding suggested a possible life cycle of the yellow fever virus in the mosquito body analogous to that of the malarial plasmodium. The final proof that the Stegomyia mosquito transmits yellow fever was given in 1899-1900 by the experiments in Havana of Reed, Carroll, Lazear, and Agramonte, and by the supplementary experiments of Guiteras and of Marchoux, Salimbeni and Simond. The Reed Commission confirmed the existence of the extrinsic incubation period (Carter) and the three days' duration of infectivity of yellow fever blood. The transmissibility of yellow fever to nonimmune individuals by direct injection of the infective blood was also established. The virus was found to be filtrable, and readily killed by heat at 50 C.; it was thought to be ultramicroscopic.

In 1918, a Yellow Fever Commission was sent by the International Health Board of the Rockefeller Foundation to Guayaquil, Ecuador, to study several problems in connection with yellow fever, among others, its transmissibility to animals, a point not sufficiently studied by previous investigators. It was found that guinea-pigs could be infected with the blood or emulsions of the organs from patients with yellow fever, and transmission of the disease to these animals was accomplished in 6 cases out of 27. The experimental disease in guinea-pigs, which followed an incubation period of 2-5 days, consisted of fever (1-3 days), jaundice, relative brachycardia, acute nephritis, and hemorrhages; death ensued within a few days. The fatty degeneration of the liver and kidneys was similar in distribution and extent to that found in human yellow fever tissues (Figs. 1 and 2), and hemorrhages into the gastro-intestinal tract were also constantly present. Recovery





EXPLANATION OF FIGURES

Fig. 1.—Fatty degeneration in the liver of a guinea-pig infected with Leptospira icteroides. Stained with scharlach R; × 110.

Fig. 2.—Fatty degeneration in the kidney of a guinea-pig infected with Leptospira icteroides. Stained with scharlach R; × 110.

from the experimental infection was found to confer on guinea-pigs a lasting immunity, just as does yellow fever in human beings. In the blood and organs of yellow fever patients and of the infected animals a minute organism was found, of which pure cultures were obtained; the organism passes through bacterial filters and is killed by a temperature of 50 C. Marmosets and young dogs could also be fatally infected, and in the latter the so-called black vomit was usually present at necropsy. Stegomyia mosquitoes became infective for normal guinea-pigs within a period of 8-12 days after sucking the blood of yellow fever patients or experimentally infected animals. The organism has received the name Leptospira icteroides.

Transmission of yellow fever from human beings to guinea-pigs and subsequent isolation of Leptospira icteroides has since been accomplished during several other epidemics: by Gastiaburu (1919) and by Noguchi and Kligler (1920) in Peru; by Noguchi and Kligler in Mérida, Mexico (1919-1920); by Perez-Grovas (1920) and Le Blanc (1921) in Veracruz. Stimson had made in 1907 an isolated observation on the presence of a spirochete in the kidney of a patient with yellow fever who died during the epidemic of 1905 in New Orleans; this organism has been found to be morphologically identical with Leptospira icteroides.

A positive Pfeiffer phenomenon with Leptospira icteroides has been obtained in most instances with the serums of convalescents from yellow fever. Injections of killed cultures of Leptospira icteroides confer on susceptible guinea-pigs and nonimmune human beings protection against the experimental infection and yellow fever, respectively, and the anti-icteroides serum checks the progress of the disease in animals or man when administered on or before the third day of illness.

From the foregoing findings the conclusion seems warranted that Leptospira icteroides is the etiologic agent of yellow fever.

AMERICAN TRYPANOSOMIASIS

STUDY OF THE PARASITE AND OF THE TRANSMITTING INSECT

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DEFINITION OF THE DISEASE AND A BRIEF HISTORY OF ITS DISCOVERY

American trypanosomiasis is a disease transmitted by hematophages of the genus Triatoma and is due to infection by Trypanosoma cruzi.

In the general symptomatology of the disease two distinct developmental phases are observable—the acute infection and the chronic. The acute infection is characterized from the parasitic point of view by the ease of recognition of the protozoon in the circulating blood in the form of flagellates, and from the point of view of symptomatology by the presence of signs of acute disease, especially of fever. In the chronic infection, on the contrary, the parasite disappears or diminishes to a considerable extent in the circulation and localizes itself in the tissues that make up the great organic systems.

The acute infection is found in the majority of cases in children during their first months, or, at most, during the first year of their life—a fact which bears on the epidemiologic conditions of the disease. In the zones infested by the triatome this insect is found in abundance in all human dwelling places, and the infecting index of the hematophages is very high. Therefore the newly born in such regoins soon become subject to inoculation by the parasite, and this confines the acute infections almost exclusively to early infancy. The acute phase of the disease is of short duartion, and as the symptoms that characterize it became attenuated and the fever disappears, the trypanosomes are no longer found in the circulating blood by direct examination and the patient passes to the chronic condition.

In the chronic phase the clinical signs are the expression of permanent alterations in the different systems and organs of the body. This aspect of the disease is independent of age, sex, race, or any other individual factor, and the patients of this category represent more or less remote infections.

The discovery of American trypanosomiasis was made under conditions which differ from the usual course of events in pathology. In this case, the knowledge of the parasite preceded that of the disease caused by it, and it was the data acquired in regard to the biology of the transmitting insect that indicated the investigations from which resulted the finding of a new nosographic entity. The first human case of infection by Trypanosoma cruzi was observed in the state of Minas Geraes in the interior of Brazil. We were there on a commission from the Oswaldo Cruz Institute carrying on an antimalaria campaign when we first came to know of the existence of a hematophage which was abundant in all of the houses. It was a blood sucker that lived in the cracks of the walls, from which it came out at night in the dark to feed on the blood of the people. During the day the insect remained in its usual hiding place; when the lights were extinguished, however, and when the people had gone to bed, the hematophage came to attack them in order to provide its own nutrition.

We examined samples of the insect and found in its digestive tubes flagellates with the morphology of Crithidia, and foreseeing the possibility of transmitting to vertebrates the parasites observed in the insect, we sent several hematophages to our master, Oswaldo Cruz, who fed them on monkeys of the genus Callithrix. One of these, fifteen or twenty days after contact with the insect, presented signs of disease, among which an acute keratitis was prominent. By examination of the blood of this animal we discovered the presence of a trypanosome which later experiments showed to be transmitted by the hematophage found in the human residences. We then inoculated the flagellates from the intestine of the insect into guinea-pigs and other laboratory animals and with complete constancy reproduced infections with a parasite identical to that observed in the monkey that served for the first experiment. In this way it was amply proved that the forms of flagellates first found in the hematophage represented developmental phases of a trypanosome of vertebrates.

With the object of finding the habitual host of the parasite, new investigations were undertaken in the regions where the transmitting hematophage had been found. As already stated, the hematophage had as its habitual habitat human residences, and this gave valuable orientation to our studies and early indicated the probable site of the animal parasitized by the trypanosome. The first work on the subject gave us an initial result, the finding of the parasite in the peripheral blood of cats in houses infested by the parasite; furthermore, we observed in the persons living in those houses symptoms of a disease which in its complex defied any diagnostic interpretation, and seemed to indicate the existence of a new disease not included in the nosographic picture. These were the points of view that led us to more persistent search, seeing that the individuals were in a diseased condition. The examinations of chronic, apyretic patients were always negative; the occurrence, however, of acute febrile infection in a child of three months facilitated the work and cleared up the obscure facts. In the peripheral blood of this little patient, whose sickness had existed for a few days, there was found by direct examination a large number of trypanosome of a morphology identical to that inoculated by the hematophage into monkeys and to that transmitted to various laboratory animals by inocluations with material from the digestive tube of the insect. Thus there was demonstrated the existence of a new human trypanosomiasis, the later study of which showed pathologic aspects of the highest interest from the point of view of general pathology, and especially, of the pathologic physiology of some of the principal organs.

STUDY OF THE PARASITE

The Parasite in the Peripheral Blood of Man.—Trypanosoma cruzi, the agent of this new disease, is found in the peripheral blood of the patient only in the initial phase of the infection. When the acute symptoms have passed and the fever has diminished or disappeared, the trypanosomes localize themselves in the tissues of the organs, and this renders difficult the parasitologic proof, which at times can only be accomplished in the necropsies. Various observations of acute cases teach us that the presence of the parasite in the blood is always of short duration, on the average from 10 to 20 days, and the cases are rare in which one can find the trypanosome by direct examination of the circulating blood after a month of the disease. The morphology of this trypanosome is sufficiently striking to make it easily distinguishable from any of the other species of the same genus: the best specific characteristic is the size and position of the blepharoplast, which is larger here than in any other known trypanosomes and situated exactly at the posterior extremity of the parasite or very near to it. In the peripheral blood of man and also in that of other susceptible animals there are observed two distinct morphologic aspects of the parasite: in one of them the trypanosome has a general thread-like form and, what is most characteristic, shows in blood smears stained by Giemsa's method an elongated nucleus in the form of a rod situated longitudinally; in the other aspect the parasite moves more slowly, in movements that are serpiginous rather than progressive, and presents a broader protoplasm and a nucleus of elliptical form, situated more or less in the central zone of the parasite.

We interpret the two morphologic types of the trypanosome found in the peripheral blood as a sexual dualism of the parasite, the thin form representing the male trypanosome and the broad form the female trypanosome. And, furthermore, this duality of sexes is well shown in the fecundation which occurs in the midgut of the triatome, where the trypanosome of the thin form attaches itself to the other, which previously assumes the rounded form. This phenomenon of fecundation, which is of such great interest in the biology of the trypanosomes, was chanced upon recently in its initial phase. Further investigations have completely elucidated the evolution of the parasite in the organ of the transmitting insect. Moreover, in the very structure of the two forms of the trypanosome and in the biologic conditions of each of them, sexual dualism was already indicated; the thin form, much richer in chromatin, of a more delicate structure, with more rapid movements, was characterized as a male organism, and the other form, broader, with less abundant chromatin and slow movements, presents the conditions of the other sex.

The Parasite in the Tissues of Man. Principal Organs and Systems in Which the Parasite Is Localized.—In the human organism and in that of all the susceptible vertebrates, the Trypanosoma cruzi evolves in two successive phases which take place in the circulating blood and in the interior of the tissues. Contrary to what is true for the other species of the genus trypanosoma, binary division in the blood is not observed in Trypanosoma cruzi, but its multiplication takes place within the tissues. In the initial phases of the infection in the acute cases of the disease and in any period in the chronic cases, the necropsies reveal abundance of the parasites in certain systems which constitute the seats of predilection of the parasite. Here the trypanosome presents itself in the form of rounded or pyriform corpuscles, destitute of flagellum and furnished with a central nucleus and blepharoplast, the latter situated near the nucleus or at the periphery. It is in this form that the parasite increases in number by successive binary divisions, from which result parasitic agglomerations, at times formed of numerous units. These rounded leishmaniform corpuscles develop into the form of the typical trypanosome, furnished with complete flagellar apparatus, and then leave the tissues and return to the circulation. It is in this way that the numerical increase of the flagellates in the blood takes place in the recent infections, that is, in the acute cases of the disease. In the chronic forms, as the trypanosomes go from the tissues to the circulating blood, they are there destroyed on account of phenomena of relative blood immunity consequent on the long duration of the infective process. It is only by admitting this immunity that we can understand the absence of flagellates from the circulation of chronic patients in whose tissues the necropsy examination has demonstrated the presence of numerous parasites.

If the infection lasts for many years, as is amply proved, and if the aflagellate forms of the tissues evolve into the typical flagellates that return to the blood, how is this absence of the trypanosome from the blood in old infections to be explained? Only the hypothesis of a relative blood immunity can explain this fact, which has been repeatedly observed in the parasitic aspect of this trypanosome.

Although it may be found in nearly all of the tissues of the organism of vertebrates, the systems most frequently parasitized are the muscular —the smooth as well as the striated fibers—the nervous, and various glandular organs. The striated muscles in man and laboratory animals constitute the constant seat of localization of the trypanosome, which is there observed in agglomerations of numerous leishmaniform corpuscles. The same is true of organs of smooth muscle fibers. However, it is in the heart that the parasite is found especially, and there it is within the cardiac fiber proper, which is invaded and occupied by it in its entire length and breadth. In this way the cardiac fiber becomes transformed into a simple sheath of the parasite, which is completely contained in the space limited by the outer membrane of the fiber. When the latter ruptures, the protozoa fall into the interstitial tissue of the organ. Throughout the entire thickness of the myocardium parasitized heart fibers are found, and in any regoin of the organ histologic sections show cardiac fibers invaded by the protozoon, some of them with only a few corpuscles and others filled with them. Only the muscle is affected; as yet parasites have not been observed in the endocardium, the pericardium, or in the valves. In man and the animals susceptible of infection the heart is the constant seat of the protozoon. From the early stages of the disease on, the necropsy examinations reveal an abundance of trypanosomes in the myocardium. And in the chronic cases, in infection acquired a long time previously, the same finding is revealed by the necropsies. We will see the importance of this localization of the protozoon when we study the pathologic processes and the general symptomatology of the trypanosomiasis.

The nervous system is another frequent seat of localization of Trypanosoma cruzi. Here the parasite conceals itself in the beginning in the plasma of the neuroglia cell, multiplies in the form of aflagellated corpuscles, destroys the cell, and continuing to increase in numbers, forms parasitic agglomerations within the nerve substance proper which are identical to those observed in the myocardium. Thus there are formed parasitic foci diffused throughout all the central nervous system with localization in the gray matter as well as in all the regions of the brain and the spinal cord. These parasitic foci of the nervous system bear no relation to the vascular system; they are observed in all the regions, even in the depths of the nervous matter, without anatomic dependence on the blood vessels. From this phase of the localization of the parasite in the nervous system result differential pathologic characteristics between the trypanosomiasis and syphilis, the spirochete of which, in its first sites in the nervous system, is subordinate to the distribution of the vascular system. In acute cases in man the trypanosome has been observed in the nervous system in various necropsies. From the localizations of the trypanosome in the nervous system in the acute infections there results, as we shall see, a condition of extreme seriousness, which is expressed by phenomena of acute meningo-encephalitis with rapid termination in death.

In man the general pathologic processes of the disease are directly related to the localizations of the protozoon in the various organs and systems.

Transmission of the Trypanosoma Cruzi to Animals.—Trypanosoma cruzi is transmissible to various laboratory animals. This is advantageous in the parasitic diagnosis of the disease and in the biologic study of the protozoon. Of the animals used in experimental work the guinea-pig, the dog, and the cat present the greatest susceptibility to the infection. The rabbit is less susceptible, and in it the infections are always relatively small. Adult dogs and cats are also more resistant, and in them the flagellates in the blood are always small in number. The resistance of white rats to this species of trypanosome is notable, and in them the inoculation is often unsuccessful even when it comes directly from the transmitting insect. In the young guinea-pig, dog, and cat the infection reaches a notable intensity after some passages of the parasite through individuals of the same species; in the first inoculation, however, whatever the source of the parasite, the number of flagellates in the blood always remains small.

Cycle of the Parasite in the Insect Transmitter.—After biting man or any other animal that has parasites in the circulating blood, the insect transmitter becomes infective for new vertebrates after the lapse of a period which is not yet determined to its minimum limit. The infective property being once acquired, the hematophage preserves it for a long time, perhaps during its whole life, and even throughout the developmental metamorphoses that it undergoes. The period during which the infective property acquired by the triatome persists has not yet been determined with great exactness; we believe, however, that it lasts indefinitely, in view of the continuity of multiplication of the protozoon in the digestive tube of the insect.

The first phase of exogenous development of the trypanosome occurs in the quilific part of the midgut of the triatome where the flagellated forms, filled with the blood ingested, undergo the morphologic mutations that we will presently describe in detail.

In the intestiniform portion of the midgut, twenty-five hours after the infecting bite, are found numerous parasites, the majority of them having the structure of flagellates of the genus Crithidia. They remain in this portion of the digestive tube for an indefinite time, always increasing in number by binary multiplication, especially when the insect is regularly fed with vertebrate blood. The flagellates here show a great variety of aspects; however, the elongated forms predominate with the central nucleus and blepharosplast situated laterally and in front of the nucleus, in relation to the anterior extremity. Such parasitic forms are very motile and easily recognizable either in the examination of material withdrawn from the intestine or in the feces that are passed spontaneously, in which the crithidias are observed in abundance. These crithidia forms are observed with absolute constancy in all the insects fed on vertebrates with parasites in the blood; however, they do not constitute the last developmental stage of the trypanosome in the digestive tube of the hematophage. Indeed, beside crithidias there are observed later parasites with the typical morphology of trypanosomes, in which the blepharoplast is situated behind the central nucleus relatively to the free flagellum. In these trypanosomes the nucleus is very characteristic and shows itself as a rod of chromatin situated in the central part of the plasm. They are very characteristic parasitic forms with narrower plasm than that of the crithidia, with serpiginous movements easily recognizable in the feces of the insect amid the crithidiaform flagellates.

We must emphasize the inconstancy of the appearance of the latter flagellates in the hematophages fed on infected vertebrates. While the parasites with the aspect of crithidia are always observed when the insect ingests contaminated blood, the trypanosome forms appear in a less regular manner, which makes us admit a determinism, not yet established, for the occurrence of this developmental phase of the protozoon in the insect transmitter.

To explain this duality of appearance of the flagellate in the intestine of the triatome, we admit the hypothesis of two developmental forms of the parasite. In one of them the trypanosome undergoes morphologic mutations identical to those found in artificial culture mediums, which consist of simple processes of division of the plasm without any process of initial fecundation. From this evolution there result as a final stage the crithidiform parasites which represent in some way the return of the trypanosome to its primitive larval condition. The other developmental form would represent the true biologic cycle of the trypanosome in the organism of the transmitter. Here there would be, as an initial phenomenon, a process of fecundation in the midgut of the insect between flagellated forms coming from the blood of the vertebrate. From this fecundation there would result parasitic forms whose state of complete development is represented by the trypanosomes found in the hind-gut. If this were so, the diversity of aspects of the flagellates in the hind part of the digestive tube of the hematophage would be explained: on the occurrence of an initial phenomenon of fecundation, which would depend on special conditions of the trypanosome in the blood of the vertebrate, the final stage of the development would be represented by flagellates with the morphology of trypanosomes; in the absence of this sexual phenomenon the parasites would reach the final stage of crithidias and would remain in it in the intestine of the insect. Direct observation does not yet authorize us to consider this doctrine as definite, but only to offer it under the reserves of a simple hypothesis. We have already in recent work shown the first phase of fecundation of the trypanosome in the midgut of the triatome, and we hope in later work to clear up the development of the parasite in the organism of the transmitter.

The evolution of Trypanosoma cruzi here described was studied in adult insects born and reared in the laboratory and infected from man or animals with parasites in the circulating blood. Identical appearances, however, are observed in the insects collected in the houses of the regions were trypanosomiasis is existent. The triatomes from the human residences in any stage of their development are usually infected, the index of infection of the insect varying with the endemic conditions of the disease. In the hematophages the parasitologic examination always shows a greater abundance of the flagellates in the hind-gut, where they are seen sometimes under the form of crithidias and sometimes under that of trypanosomes. The intensity of the infection is quite variable; in some hematophages the parasites are numerous in the hind-gut and in the feces passed naturally, while in other insects the number of flagellates is very small. The parasitic forms of the hind-gut do not constitute the last stage of evolution of the trypanosome in the transmitting insect. Aside from these, others of a characteristic aspect have been found in the salivary glands, and these represent the parasitic forms inoculable into the vertebrate. This discovery has been a difficult one and up to the present has been realized rarely; however, its importance is not less as being demonstrative of the exact mechanism of transmission of the parasite. In the salivary glands the parasite has been seen in the interstitial tissue between the glandular cells. Here it is elongated, with a rodlike nucleus placed longitudinally, with much smaller dimensions than the forms of the hind-gut, with which it cannot be confused. This is the final stage of the exogenous cycle of the parasite equivalent to the sporozoites of malaria and of other protozoa transmitted by hematophages.

STUDY OF THE TRANSMITTING INSECT

The transmitter of the American trypanosomiasis is Hemiptera heteroplero, of the family Reduviidae, and genus Triatoma. The first species recognized as a transmitter of the disease was Triatoma megista; aside from this, however, the other species of the same genus can carry out the transmission, as has been proved with regard to Triatoma sordida infestans, and geniculata. Triatoma megista is in our opinion the specific transmitter par excellence, that is, the one in whose organism the evolution of Trypanosoma cruzi is best accomplished.

Artificially fed and under the temperature conditions of the tropics, the evolution of the triatome from egg to imago takes a minimum period of two hundred and seventy-one days. Under natural conditions of life it may at most show slight variations attributable to accidents of nutrition of the insect. In the laboratory the triatome lives for several months, and we have already observed specimens, periodically fed and in full activity, that have lived one hundred and fifty days. As the hematophage can transmit the parasite in any of its three phases of larva, nymph, and winged insect, by adding together the duration of the three periods of life, we can estimate at approximately four hundred days the period during which a triatome may exercise its rôle as transmitter of the disease. This fact well exemplifies the epidemiologic importance of a single hematophage, which when once contaminated may be the propagator of the parasite for a long time, contrary to what is true for other insects that are transmitters of various pathogenic germs, whose life is usually of short duration, which restricts the epidemiologic importance of each of these hematophages.

MECHANISM OF THE INOCULATION OF THE TRYPANOSOME

Infection by Biting and Infection by Feces.—The natural process of the inoculation of Trypanosoma cruzi into the organism of the vertebrate is by the bite of the insect, as happens with the majority of the parasites transmitted by hematophages. The transmission by bites was demonstrated experimentally in the researches of Magarinos Torres, who protected himself from any cause of error, and accomplished the infection of various laboratory animals by allowing them to be bitten by the insect. In these experiments only the proboscis of the hematophage entered into contact with the vertebrate and all possibilities of transmission of the parasite by the feces or by any other means were avoided. In various laboratory experiments with insects collected in human residences and with others reared and infected in the laboratory, Magarinos Torres in an indisputable way demonstrated the transmission by the bite. Furthermore, the presence of the flagellate was already demonstrated in the salivary gland of the insect and this constitutes a decisive demonstration of the process of inoculation by biting. It is true that the search for the flagellates in the salivary glands has not given the constant results that would be desired; on the contrary, rarely have we succeeded in verifying that final developmental stage of the protozoon in the organism of the transmitter. In spite of this it is not possible to admit doubts as to the natural process of the transmission of parasites, since in other protozoon infections and even in trypanosomiases, which are evidently inoculated by bites, it has not yet been possible to verify parasites in the salivary glands of the insect, and at times it is not even possible to recognize the organisms of inoculation. In the case of Trypanosoma cruzi, after the repeated experiments of Magarinos Torres, which were carried on with a technical rigor that completely excludes any other mechanism of transmission, the inoculation by the bite of the insect is amply demonstrated. However, is this the exclusive mechanism of inoculation of the parasite? Certainly not, for it has been amply proved that the feces of infected insects placed on the mucous membranes of susceptible animals constantly brings about the infection by the trypanosome.

As we have already said, the flagellate is observed in the feces of the triatome in the forms of crithidias and of typical trypanosomes. The subcutaneous inoculation of naturally passed feces determines the infection with certainty in the laboratory animals. These facts, allied with the inconstancy of obtaining infection by biting, have led some investigators to promulgate the idea that the natural transmission of Trypanosoma cruzi is accomplished by the feces and not by bites of the insect. According to Brumpt and Piraja de Silva the inoculation of the parasite would be accomplished as follows: the triatome deposits the feces on the skin of the individual and, on account of the itching caused by the bite, the individual scratches the region affected, so that the nails produce slight abrasions which form the points of entry of the parasite. The inoculation would be caused in this way or by direct defecation on the mucosae of the eyes or mouth. Brumpt, who has shown that Trypanosoma cruzi easily passes through the mucosae, wishes to make a general doctrine for others, or for all the trypanosomes, of the processes of inoculation by the skin and by the mucous membranes. On the other hand, he considers the transmission by biting either as not occurring or as only an accidental and exceptional factor. With regard to Trypanosoma cruzi the opinion of this notable investigator does not seem to us acceptable. In the first place, the inoculation by biting has been experimentally demonstrated as possible and the trypanosome has been observed in the salivary gland of the insect. Furthermore, it must be noted that the feces of the hematophage when once passed undergo rapid drying which results in the death of the flagellates. This being so, the infection by the skin could only be accomplished on the hypothesis that the feces are deposited on a region of the cutaneous surface that has been previously excoriated. At any rate Brumpt by repeated experiments demonstrated the difficulty of the penetration of the flagellate through the intact skin even in newly born animals. As to the excoriations produced by the nails, it must be noted that the bite of the insect is painless and does not provoke any itching. Two chief facts constitute a decisive objection to Brumpt's doctrine with regard to Trypanosoma cruzi: rapid drying of the feces of the insect after being passed and difficulty of penetration of the parasite through the intact skin. This being so, the only process of transmission of the parasite remaining would be the penetration of the mucous membranes as a consequence of the accident of the defecations occurring directly on the ocular or buccal mucous membrane. We do not doubt this last occurrence, which has been well shown in the experiments of Brumpt and in others carried on later in our laboratory. But to consider this accidental mechanism of transmission of the parasite as the rule and to place on a lower plane the biologic process of the bite does not appear reasonable to us; the experiments of Torres have resolved the subject by demonstrating the infection of the vertebrate by the bite of the contaminated insect to be possible and frequent.

According to Brumpt, the infection of vertebrates by some species of trypanosomes transmitted by hematophages would be accomplished by the ingestion of the transmitting insect. In this way that investigator emphasizes the importance of the feces in the transmission of the trypanosome and later refers to the infection of the rats as due to the fact that these rodents eat the fleas or lick the hairs contaminated by their dejections. This doctrine would at once be inapplicable to the transmission of trypanosomiasis to the great mammals by the glossinas of the African continent. As a result of decisive experiments and observations we can express the firm opinion that the natural transmission of Trypanosoma cruzi is accomplished by the bite of the triatome. The feces may constitute an accidental factor in the transmission of the parasite when they are deposited directly on the mucous membranes; however, if the defecations of the insect take place on the intact skin the penetration of the parasite does not occur, principally on account of the death of the flagellates by the desiccation of the feces.

RESERVOIR OF THE PARASITE IN THE OUTER WORLD

Trypanosoma cruzi, first found in the digestive tube of Triatoma megista and in the blood of man and the cat, was later found in the intestine of another species of triatome, Triatoma geniculata. This hematophage, unlike the first, is almost exclusively of sylvan habits, living in holes in the ground which form a shelter for a vertebrate that is common in Brazil, the tatu or armadillo. In a manner similar to what happens in the case of the flagellate of Triatoma megista, the parasite found in the Triatoma geniculata represents developmental forms of a trpanosome whose vertebrate host is the armadillo. In the peripheral blood of Tatus novencinctus, captured in the holes where were collected infected Triatoma geniculata, we found trypanosomes with a morphology identical to that of man and which reproduced in guinea-pigs infections identical to those caused by the human parasite. On the other hand, what better identifies the species of trypanosome and establishes the exact nature of the infection of the armadillo is the fact that the inoculation of the parasites of the digestive tube of Triatoma geniculata, collected in nature, in all susceptible animals caused infections with trypanosomes identical with those found in the armadillo and in man, both in their morphology and in their biology. In this way the existence in the outer world of a vertebrate host of Trypanosoma cruzi was well established and also that of a specific transmitter of the parasite. Thus, beside a house infection this trypanosome causes a sylvan infection, there being naturally between the two the difference of the transmitting species. Later investigations have shown that besides Tatus novencinctus other species are parasitized by the same trypanosome, which is observed with frequency in Dorypus sexcinctus and Dorypus unicinctus. Furthermore, it has been fully demonstrated that the infected armadillos are not only those collected in the regions inhabited by man and near the human residences; species captured in distant and entirely uninhabited places also show the trypanosome. The great frequence of the parasite in the armadillos has also been demonstrated, and, in certain places, they show a high infective index.

These facts, together with the low position in biologic development of the Daripodidae, which probably preceded man in the regions in the interior of Brazil where trypanosomiasis is endemic, caused us to conclude that the armadillos represent the primitive host of Trypanosoma cruzi, which is at present a human parasite through biologic adaptation which has been accomplished in the course of time. The armadillos still constitute a permanent reservoir of the trypanosome in the outer world, and this fact is of great epidemiologic importance for the following reasons: The trypanosome that infects the armadillo has as its specific transmitter among animals of the same species Triatoma geniculata, a hematophage now adapted to life in the holes of the armadillos; this triatome, however, accidentally frequents human residences where we sometimes find it, which makes possible the contagion of man by the trypanosome of the armadillo. This being so, the Triatoma geniculata which perpetuates the infection by Trypanosoma cruzi in the outer world may constitute the carrier of the disease from its sylvan condition to the houses where it is perpetuated by the transmitting action of Triatoma megista. Brumpt also had the opportunity to demonstrate the presence of Trypanosoma cruzi in the digestive tube of a new species of triatome discovered by him and called Triatoma chagasi. This hematophage has been found in holes frequented by armadillos and other mammals.

Brumpt offered the hypothesis that this triatome is the primitive transmitter of the trypanosome the specific host of which in the outer world is Cerodon rupestris; however, confirmation of Brumpt's doctrine has not resulted from the prolonged investigations of Magarinos Torres, the parasite never having been found in Cerodon rupestris.

This being so, we remain with the conviction that the primitive host of Trypanosoma cruzi is the armadillo, and this at present constitutes a reservoir of the parasite in the outer world.

CLINICAL ASPECT OF TRYPANOSOMIASIS

American trypanosomiasis is observed under two essential aspects: an acute infection and a chronic one. In the acute infection are included cases in the first phase of the disease presenting the initial symptomatology, in which the febrile reaction predominates. This condition of the disease is principally characterized by the presence of flagellates in the peripheral blood. The chronic infection includes the infected patients who have escaped death in the first phase of the disease and in whom are observed clinical syndromes, predominating on the side of certain apparatuses or organic systems, according to the localizations of the parasite and to the lesions occasioned by them.

I will discuss the acute infection in general outline. This is almost always observed in children during their first months or, at most, within the first years of existence. Acute infections occur almost exclusively in infants on account of the domiciliary condition of the disease and the high infecting index of the hematophages in the human residences.

The child, as soon as it is born, becomes subject to the bites of the triatome and consequently to inoculation with the parasite; for this reason it becomes quickly infected. Does hereditary transmission of the parasite occur? As yet we are not in a position to give a definite solution to this point which is of great importance in the epidemiology of the disease; we believe, however, that the transmission of the disease by intrauterine contagion often occurs, in spite of the fact that we have not yet succeeded in obtaining unquestionable evidence of it. We think thus because otherwise many facts of common osbervation, such as the fact that individuals present evident symptoms of the disease without having experienced any former acute attacks, would be inexplicable. Considering the fact that trypanosomiasis in its pathogenesis presents an appreciable similarity to syphilis, it is not to be wondered at that in this point they also bear resemblances.

The duration of the course of the acute cases has varied in our observations between ten and thirty days. One of two events may then occur: either these cases terminate in death within a few days or they pass to the chronic form, with a course which is sometimes long, so that the infected person may reach an advanced age, although with appreciable anomalies in some organic systems.

In the acute form there is always a complex of pathognomonic symptoms that are absolutely constant and not confusable with other diseases. This is the general symptomatology of these cases: continuous fever persisting while flagellates exist in the peripheral blood, reaching a temperature in the more serious cases of 40 C., with slight morning remissions; spleen and liver always enlarged in volume; general glandular enlargement, the glands of the neck being appreciable in large numbers and those of all the peripheral plexuses being enlarged. Finally, as a more characteristic sign we must refer to the swollen face, so that the patient appears bloated; so peculiar to trypanosomiasis is this appearance that it constitutes one of the most certain symptoms for the diagnosis of the acute forms, raising the suspicion as to the nature of the infection even at a distance. This last sign, on which we must insist, is one of the most peculiar in trypanosomiasis; some days after the appearance of the febrile reaction and after the child presents itself as a patient, the parents note the appearance of this tumefaction, which is most marked in the face and other regions of the body, this as a rule being the sign of disease that attracts most attention and leads them to seek the physician.

By clinical investigation it is easy to prove that this is not a case of renal edema but rather one of myxedematous infiltration, of generalized myxedema, and this is confirmed by the histologic examination of the subcutaneous cellular tissue in which the reactions of mucin are appreciable. Thus in the acute forms of trypanosomiasis one of the elements of myxedema is observed with extreme frequence, this being a fact which indicates a functional alteration of the thyroid gland in this initial phase of the infection. And the necropsies in cases of this nature, by showing the presence of the parasite and histopathologic processes in this gland, give a foundation for this symptom and make evident the attack of the parasite on the thyroid gland.

From the point of view of prognosis the cases of acute infection are divided into two groups: in one of them there are symptoms pointing to involvement of the nervous system, and the patients present appreciable signs of acute meningitis; and in the other such signs are not observed. In the first group of clinical cases the gravity is much greater and termination by death within a short time is the rule; and at necropsy marked lesions are found in the brain and meninges with localization of the parasite in the brain substance. The anatomopathologic signs are those of an acute meningo-encephalitis, and the parasitic foci may be observed in any part of the brain. In these clinical cases the greater abundance of the parasites in the peripheral blood should also be noted. On the other hand, in the acute cases without meningo-encephalic symptoms death is rarely observed, the patients usually passing to the chronic state.

Let us proceed to consider the principal aspects of the chronic infection. The predominance of some syndromes on account of the localization of the parasite in certain organs justifies us in admitting some principal clinical forms in the chronic infection; but we must state that between these forms there are no sharp limits, because in all there are some symptoms which are constantly present and constitute the essential characteristic of the disease. In some cases, however, the symptomatology is more accentuated in certain organic systems, and this gives a basis for the systematization of the disease into some clinical groups in which certain functional changes predominate. We shall study the principal of these clinical aspects in a general way, it not being possible here to enter into minute descriptions.

CARDIAC FORM OF THE DISEASE

Among the most notable facts in the pathology of this disease are the localizations of the parasite in the cardiac muscle of man and laboratory animals, within the proper fiber of the myocardium. This being so, it can be understood that in the clinical expression of trypanosomiasis cardiac symptoms at times figure in a predominating way. The heart changes in this disease form one of its most curious aspects, and in them we find a great mass of facts that are of value in elucidating the points that are still obscure in cardiac pathology. This is true because, by the aid of the functional change which is appreciable by clinical methods, it is not difficult to verify the etiology and pathogenesis which are represented by the parasite in the myocardial cell and by the lesions determined by it in the whole muscle.

From the beginning of our clinical studies of the disease, our attention was attracted by the cardiac arrhythmia in young persons without any sign of generalized sclerosis, and without symptoms of any inflammatory process in the kidneys. The cases of this nature that came under our observation in a relatively short space of time and in a diffuse population were numerous. Certainly outside of the epidemiologic conditions of the regions in which we were studying, alterations of cardiac rhythm were never observed in so high a number in young people. In such patients there are always found other symptoms of infection; here, however, the changes in the circulatory apparatus predominate.

The first necropsies of the disease soon explained this fact of constant observation by demonstrating the parasite in the myocardium and the lesions there caused by it in acute and chronic cases of trypanosomiasis. In laboratory animals numerous experiments also indicated the predilection of the parasite for the cardiac fiber. Those properties of the cardiac muscle fiber that become principally affected are those of excitability and conductibility, according to numerous observations that we now have.

The alterations of excitability include extrasystoles which occur here with extreme frequency and under the most variable forms. There are seen characteristic extrasystoles of auricular origin and others of ventricular origin. From the point of view of frequence of the extrasystole there are also presented the most varied appearances, as they occur either infrequently interspersed between the normal systoles, or repeated in each cardiac cycle, giving to the pulse the classic aspect of bigeminism. Many other aspects are here observed in which all the variations of cardiac rhythm may be characterized.

It is worthy of note that these alterations of rhythm are observed at any age, even in children of 6 and 8 years; and it should also be noted that, in spite of the abundance of parasites in the myocardium in the acute cases, in these there do not occur alterations of rhythm but rather a great insufficiency of the organ. We believe that such alterations depend on processes of diffuse myocarditis with interstitial sclerosis of the organ, an anatomic condition which is still absent in the early stages of the disease and only found in the chronic forms.

Next to the arrhythmia from extrasystoles attributable to disturbance of excitability, come in order of frequency the alterations in the conductibility of the myocardium. Here are observed all grades of disturbances of the function, from its initial decline to complete elimination in which the ventricular rhythm is independent of the rhythm of the auricle. In the initial depressions of the function it is curious to note the cases in which in the tracings from time to time an auricular systole is not transmitted to the ventricle, thus causing intermittent gaps in the radial pulse. In this way occur the numerous cases of relatively slow pulse that are observed in the zones of the trypanosomiasis with less than 60 radial pulsations per minute.

When the bundle of His is attacked, with profound disturbances of the conductibility of the muscle, there result cases of complete heart block, the true Stokes-Adams syndrome, in which there are not lacking the concomitant nervous disturbances. The number of patients already observed with this syndrome is high; and we can state that, in this particular, trypanosomiasis presents a pathologic condition that is peculiar to it, no other disease existing in which the slow pulse is observed with so great a frequence. Especially notable here is the observation of heart block even in children from 8 to 12 years of age.

Without doubt, the cardiac form represents one of the most curious clinical aspects of the new disease and also that of the greatest fatality in the chronic forms. Death caused by this diseased condition usually occurs from asystole due to progressive weakening of the heart. The patients then present generalized and progressive edema, visceral congestion, and other symptoms that characterize cardiac asystole.

Another mode of death that is of great frequence in the zones infested by trypanosomiasis, is sudden death from cardiac syncope. This fact causes wonder in all those regions in which we have studied the disease; young persons relatively healthy die suddenly, sometimes while at work, without any recent symptoms that could make one foresee this event. The exact mechanism of this death has been the object of prolonged investigations in our studies, and it is possible to interpret the accident under two hypotheses: either they are cases of complete heart block, death occurring in the long pauses in the cardiac pulsations, or we are dealing with a phenomenon of auricular fibrillation, which is still poorly understood in man. Concerning this last hypothesis we have a curious observation, the report of which cannot be included within the limits of this summary description. Be that as it may, sudden death in trypanosomiasis is frequently observed and is associated with the profound changes of the myocardium caused by the localization of the parasite.

NERVOUS FORM

Histopathologic studies carried out in necropsies on the bodies of persons who had presented nervous symptoms simultaneously with other symptoms of the disease have shown localization of the parasites in the central nervous system and lesions caused by it there. It is impossible in this résumé to discuss the nervous form of the disease in its various and curious aspects, and I prefer to discuss interesting phases of the disease. From the beginning of our clinical studies we observed numerous cases in which organic affections of the nervous system coexisted with other signs of the disease.

The high coefficient of nervous syndromes in the zones of trypanosomiasis, the cases of paralysis, of aplasia, of idiocy, observed principally in children or in persons of retarded development soon formed one of our greatest clinical surprises, indicating at the same time the high pathogenic importance of the parasite, in case it would be possible to demonstrate it as the etiologic agent of such nervous changes. We were naturally led to the association of the nervous syndromes with trpanosomiasis by the existence of other clinical signs of trypanosomiasis in the patients referred to, and by the negative results of all investigations in which attempts were made to find another etiologic factor; a negative Wassermann reaction, absence of physical signs of syphilis—exact clinical studies all excluded the interference of the treponema of Schaudinn in such alterations.

The first necropsy on a child that had died with signs of acute meningo-encephalitis gave an anatomic base to our clinical observations and justified the creation of the nervous form of the disease. The principal anatomic characteristic of the localizations of the parasite in the central nervous system and of the lesions there produced is that they are in multiple foci, scattered in different zones of the brain, in the cortex, bulb, etc., and without any relation to the arterial system. This multiplicity of localizations is well expressed by the various forms in which the nervous syndrome presents itself in the clinical cases. Among the motor disturbances the type most frequently occurring is cerebral diplegia, in which, as a rule, the spasmodic phenomena predominate over the paralytic. However, such diplegias, which are generally consequent on infections acquired during early life, from the point of view of extension and intensity of the disease present great variations of aspect, from simple bilateral dysbasia expressive of anatomic scars consecutive on lesions of slight extent up to the forms of generalized rigidity, the true Little's syndrome.

In any of the nervous forms of the disease the historical data usually refer the beginning of the nervous changes to acute attacks, probably of meningo-encephalitis occurring in early life; however, we know of cases of primitive localization of the parasite in the brain, the disease proceeding from its beginning with a silent course without symptoms of an acute meningo-encephalitis.

The intelligence is always affected in the nervous forms of the disease, and intellectual deficiency is here observed from the most complete idiocy to the simple states of retardation, and there is no obligatory relation between the intensity of the motor disturbances and the degree of mental decadence. Many cases classifiable as complete idiocy present slight motor changes expressed simply by exaggeration of the tendon reflexes, dysbasia, etc.; on the contrary, there are cases of profound motor disturbances with relative preservation of the intelligence.

Alterations of speech are also not rare, and there are a large number of diplegics who show a total aphasia. While this, on the other hand, is almost always accompanied by motor disturbances, as times it constitutes the most salient manifestation in patients with slight alterations of motility. Generalized or partial convulsions are also frequently observed in the disease and express lesions of the cerebral cortex. They have been observed with all of the clinical aspects of the nervous form of this disease. Suprabulbar paralysis has also often been observed in cases of diplegia, sometimes amplifying the nervous syndrome and sometimes constituting isolated paralytic manifestations in persons with other signs of the disease but with normal general motility and tendon reflexes. It is not difficult to understand the existence of these suprabulbar paralyses when we know of the diffusion and multiplicity of the parasitic foci in the neuraxis.

The results of trypanosomiasis on the nervous system having thus been described in a summary way, I shall refer in bare outline to some other aspects of the disease concerning which there still are certain objections, either relative to their association with the infection or to the method of interpreting their exact pathogenesis.

INFANTILISM

Cases of retarded growth with total arrest of physical development are frequent in the zones of trypanosomiasis. Many of the patients in this group represent classic types of myxedematous infantilism with evidence of hypofunction of the thyroid gland; others, however, are far from that type and do not show appreciable signs of hypothyroidism. Must we establish relations of cause and effect between this infantilism and infection by Trypanosoma cruzi? Certainly. In the first place, aside from arrest of development, other signs indicative of the disease are found in such patients. In some necropsies the parasite has been found in its seats of preferred localization. Aside from this, it must be emphasized that the parasite localizes itself in the essential endocrine organs and systems, such as the thyroid gland, the genital organs, the suprarenals, etc. Here it has localized itself and caused lesions that change the functional correlations between such systems or destroy the necessary antagonism. This being so, it would not be possible to deny the influence of such changes on the total physical development of the patient.

Nor is it to be wondered at that infantilism figures among the results of infection by Trypanosoma cruzi. The analogy for this aspect of the disease is found in syphilis, the pathology of which presents notable points of contact with that of trypanosomiasis. Does syphilis not include infantilism among its consequences? And why may this not also be the case with American trypanosomiasis, when the contagion in this disease may also take place during intrauterine life or the infection may be acquired during the first months or even during the first days of existence? I have no doubt that in the zones of the "barbeiro" infantilism constitutes a result of the disease; investigations are in progress which may better elucidate this point.

ENDEMIC GOITER AND TRYPANOSOMIASIS

A point that is also debatable is what is said with regard to the relations, if there are any, between American trypanosomiasis and the goiter that is endemic in the regions where the disease exists. In rapid synthesis I shall give the reasons that cause us to consider the goiter endemic in the infested regions to be a result of infection by Trypanosoma cruzi.

One of the most salient clinical signs in the acute form of the disease is the mucoid infiltration of the subcutaneous tissue. This is a constant sign and indubitably expresses the interference of the thyroid gland in the pathologic condition. We must note that, in the large number of observations that we possess, we are treating of children who were formerly free from any of the signs of myxedema, this having appeared days after the beginning of the infection, that is, as an immediate consequence of it. Furthermore, in necropsies on acute cases the parasite has been observed in the thyroid gland, which forms another argument in favor of our opinion.

On the other hand, in numerous cases of goiter studied in the zones of the "barbeiro" the coexistence of symptoms of trypanosomiasis is constant, and if in many cases of the disease it is easy to verify absence of appreciable hypertrophy of the thyroid gland, it is difficult to verify the inverse condition.

The facts of the epidemiology and of the geopraphic distribution of the disease also give foundation for the same opinion. Thus it is that in the infested zones goiter is only found in persons who reside in houses where the transmitting insect is encountered; while the inhabitants of houses free from infestation by the hematophage, although under the same conditions of life, fed in the same way and drinking the same water, do not show lesions of the thyroid nor the effects of goiter. As to the geographic distribution of the disease and of endemic goiter in regions of the interior of Brazil, our observations superabundantly show the coexistence of goiter and the hematophage that transmits Trypanosoma cruzi, and as yet we have not been able to find any region infested by the triatome in which goiter does not exist.

It is true that the presence of goiter in some of the zones along the coast of the country in which the "barbairos" have not been found seems to contradict this doctrine; however, we must state that we have never affirmed that goiter is always a consequence of infection by the trypanosome, which would be absurd. We believe in the diversity of etiologic factors of struma, and even in our country we have the conviction of the diversity between the goiter observed in certain regions of the coast and that which constitutes the great endemics in the zones where the trypanosomiasis exists. To recapitulate our idea in this respect, we will say that we associate the endemic goiter observed in the regions of the interior of Brazil, which are infested by the transmitting triatome, with infection by Trypanosoma cruzi. We have strong arguments that lead us to think in this way; in spite of this, however, we do not consider this point definitely elucidated, and we believe necessary other investigations which we will take up in order to give our doctrine indisputable proof or to make it unsupportable.

THEORIES OF SUSCEPTIBILITY AND RESISTANCE IN RELATION TO METHODS OF ARTIFICIAL IMMUNIZATION

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> It is provided in the essence of things that from any
> fruition of success, no matter what, shall come forth
> something to make a greater struggle necessary.
> —Walt Whitman: "The Song of the Open Road."

The function of great men seems to be not only to bring revolutionary ideas and concepts into the world before they are due, but vigorously to maintain and defend them in a hostile environment. Many great ideas are launched but not developed and defended. The systems in vogue are either indifferent or hostile to them and the individual unable to meet indifference or hostility, hence they are lost for the time being. Pasteur not only brought fourth ideas revolutionary to biologists, chemists, and physicians of his age, but he developed and perfected them and advanced them into practical life in the face of great opposition.

Medical science is particularly indebted to him for his pioneer work in the immunization of the body against infectious diseases. Since his time his fruitful ideas and achievements have given origin to two more or less commingling streams of scientific and practical endeavor; one devoted to the further development of methods of protective inoculation, the other to the elucidation and analysis of the complicated biologic machinery underlying acquired immunity.

Confronted with the fullness of knowledge brought to light by the generation since Pasteur's earlier work and set afloat on these two streams, the writer, who has worked through this past generation, realizes that there is a certain congestion and blockade which tends to leave us near some Tower of Babel. It seemed therefore worth while not so much to penetrate into the subject as to define it from the outside, to circumscribe it by a statement of accepted compelling facts based on general biologic concepts. I have therefore used few technical immunologic terms and given no references since the ideas will be found elsewhere if search is made for them.

BIOLOGIC ASPECTS OF SUSCEPTIBILITY AND RESISTANCE

In a recent paper I emphasized the fact that all parasites, from the ultramicroscopic to the larger worms, which go from host to host within the same species, must pass through some cycle which involves the critical phases of entry, multiplication, escape, and transit to another host. Each one of these phases is made up of series of minor stages following each other in definite succession. Every parasite has a cycle differing in major or minor details from every other parasite. The phases of these cycles are undoubtedly associated with physiologic and perhaps with morphologic changes in the parasites. The bacteria are unfortunately not susceptible to much analysis with our microscopes, but much has been suspected and written, as shown by the recent monographic compilation of F. Löhnis (1921). The discovery of a series of stages in the sporozoa, involving both vegetative and reproductive processes, makes it probable that the parasitic bacteria may not be without similar, even though very rudimentary phases. Interpretation of morphologic divergencies are at best difficult. The many explanations which the microgametocyte or the so-called flagellated organism of the malaria parasite passed through before its relation to the sexual cycle was made clear should suggest caution in sweeping aside the interpretation of active phases in favor of the well-worn one that they are involutions of bacteria. The many important observations on mutations, on the enzymes of bacteria, on sensitiveness to oxygen tension, and on the phenomenon of d'Herelle indicate that we have still much to learn of the manifold capacities of even the commoner bacteria.

The continued existence of the parasite presupposes escape sooner or later to a new host. This is accomplished by the localization of the parasite near convenient places of exit, chiefly on, or in, or under the skin, the mucous membranes of the respiratory, digestive and genital tracts, and the glands secreting outwards, such as the testicles and mammary gland. These conditions are fundamental, and I think will be accepted as real by all those who have given some attention to bacterial, protozoan, and higher parasites.

Besides the complete cycles of parasites there are many incomplete and aberrant cycles. They may be internally aberrant in so far as the parasite departs from the normal route through the host, or they may be externally aberrant when parasites belonging to one host get a partial foothold in another. There may be multiple or consecutive invasions into the same host. All these departures from the normal parasitic cycle are responsible for a large part of the sum total of what we call disease. They complicate study and postpone solutions. They make moderate disease severe and fatal and interfere with both preventive and therapeutic measures.

The phase of the parasitic cycle which is significant to both parasite and host is the multiplication of the parasite in the tissues, or the vegetative stage. In this stage the parasite must injure tissues to a certain degree and in case there is more or less destruction of the progeny of the invading parasite foreign protein, toxins, enzymes and the like must be disposed of. The injury is quantitative and in all adjusted parasitisms multiplication is held in check or controlled by the host. The relation between the two is a flexible adjustment or truce, for the failure of self-protection on one side is identical with overactivity on the other.

The special relations existing between parasite and host have their roots in the distant past. In the formation of these relations both host and parasite had to give way. Natural selection had to eliminate from both before the existing arrangement came to a fair degree of stability. This mutual adaptation will explain the special group of parasites centered about each mammalian and avian host, to mention only species related to us and of economic importance. That relations between hosts and parasites should now and then be found to exist not explainable by natural selection and adaptation but due to accidental relationships need not surprise us.

The rapprochement between certain hosts and certain developing parasites implies an equal estrangement between other hosts and these same parasites, often terminating in the formation of species and even genera of parasites from the same ancestral stock by adaptation to different hosts. This adaptation to one host leads to the immunologic concepts of susceptibility and immunity. A given host which becomes the habitat of a certain parasite is susceptible. Another host owing to physiologic differences becomes immune to the same parasite.

The foregoing inevitably leads to the doctrine that the specialization of parasites and their host restrictions are due as much to the host as to original endowments of the ancestors of the parasites themselves. Specificity of a parasite is, in part at least, the stamp put on it by the host If this is true it follows that in the normal host, independent of any earlier invasion of his parasites, certain functions are correlated with those of the parasites he as a species possesses. In the language of

Ehrlich, we might say that there are certain nutriceptors in the host correlated with certain activities of the parasite. This would define for us what is meant by susceptibility. It is a positive rather than a negative attitude, at least in the early stages of the parasitic cycle. This definition of susceptibility leads directly to a definition of natural immunity, that condition of the body which is unfavorable to the multiplication of certain parasitic organisms. In some cases it reveals differences between closely related species or even races; between house mice and field mice, chickens and pigeons, white mice and Japanese waltzing mice, not to mention the many differences existing between man and the domestic animals with reference to their parasite equipment.

If our definition of susceptibility approximates the truth, natural immunity may be defined as a lack of those physiologic states or functions possessed by the susceptible animal which favor the parasite. The immune species or race is without that which reacts in the presence of the parasite and causes enough disturbance to furnish a nidus for multiplication and such food material as is set free by the reaction or disturbance of function. This reaction may involve both primary toxic and anaphylactic phenomena, or at least certain modifications of them. This definition is in harmony with the generally accepted doctrine that both natural immunity and susceptibility are histogenic; that immunity, however, which is simply based on the fact that some one link in the chain of parasitism is defective, such as the capacity to enter the host, is not fundamental, for the link may at any time be supplied and thus create susceptibility. Immunity to be basal must fail to supply that link which promotes the multiplication of the parasite in the host, for in the end this stage is most dangerous to the host and important in providing for the continued existence of the parasite

There is one type of more or less complete resistance which manifests itself where diseases have been prevalent or endemic over long periods of time. Even in small groups, herds, or flocks, a disease sooner or later plays itself out through a slowly rising resistance of the group, provided fresh individuals and races of virus from other groups are not brought in. This kind of resistance may be a high degree of acquired immunity, due to vicarious vaccination from early life on with small doses, possibly with the cooperation of a passive immunity developed during fetal life or the lactation period, or it may be a gradual decline of reactivity to the presence of the living parasite, or what is still more probable, both processes may be at work until the second is completed and natural immunity finally established. Natural immunity thus may grow out of susceptibility by a gradual loss of those normal physiologic reactions to invasion which favor the parasite. Natural immunity like natural susceptibility exists only with reference to specific parasites. The host species immune to one parasite may be highly vulnerable to another closely related to the former. Parasites of one host may be as vulnerable in another host as are free living organisms. The parasitic acquisition is specific with reference to one host, partially so with reference to some others, and negative with reference to still others.

If we now consider those processes which stand out as of primary significance to both host and parasite—the multiplication, survival, and discharge of the latter—are we in a position to circumscribe these phenomena and thereby limit the field of inquiry? That they are different for every group of parasites may be assumed, but how superficial or deep the differences are cannot be told until the behavior of every group is studied individually. For this study the past generation has furnished much material, but it remains to fit it to each parasite. The forces of the host directed against the parasite are presumably stimulated by the metabolic and growth activities of the latter, and among these we must look for the antigens that count. The antigens locked up in the parasites and available only after the parasites are dead and disintegrating cannot be of any importance, if normal forces must first kill to make antigens available. The sufficiency of resistance rests in the destruction of the parasites, and if this is done before certain antibodies can be mobilized and overproduced they cannot be essential to the host's protection.

There are probably a variety of ways in which multiplication is suppressed. It is conceivable that the interference with a single function may be sufficient. The host probably accomplishes this suppression either by direct destruction as when the cholera vibrio is introduced into the immunized guinea-pig, by interfering with the normal metabolism as in the antiblastic immunity of Ascoli, Dochez and Avery, or by inducing the formation of some protective envelope around the parasite. In any case the host is protected when, and as long as, multiplication is suppressed. The mere presence of a few parasites is of little or no significance.

In the highly adapted parasites the multiplication is more or less definitely measured out to the parasite by a delicate balancing of forces. As a rule, the induced disturbance or disease is moderate, nonfatal, unless complicated by other parasitic invasions. There are, to be sure, always hypersusceptible hosts to be weeded out—to restore the host-parasite equilibrium.

In the partially adapted and aberrant parasites, the relation between host and invaders is less clear. In this class belong all experimentally induced diseases when another host is substituted for the natural one. The body probably brings into play whatever forces are available, i. e., whatever forces are stimulated by the particular parasite involved.

Since the discovery of the antitoxins, the so-called antibodies have been in the forefront of all theories bearing on host-parasite relations. These bodies, which appear in quantity usually some time after the invasion, are supposed to suppress the multiplication of parasites in some way. But there is ample evidence that some inhibiting forces are active from the start. They may be considered normal antiforeign forces, and it simplifies our theories considerably if we assume that they are also the immune bodies stimulated later to overproduction by the products resulting from the multiplication of the parasite. If the immune bodies are not normally present, eventually overproduced bodies, then we must assume the existence of normal forces active at the outset and producing much the same results until the immune bodies are mobilized. There are, however, physical and chemical conditions in the tissues not antigenic in character which may oppose multiplication either wholly or partially. If wholly, the host must be regarded as naturally immune.

We may then presuppose a steady opposition to multiplication from the start on the part of the host, which is countered by the parasite and which eventually gives way or suppresses multiplication completely after a certain period. The sources of the specific antibodies have been referred to the organs producing lymphoid, polymorphonuclear and other cell elements, such as the lymph nodes, bone marrow, and spleen. It is not improbable that antibodies may be products of actively secretory cell tissue as well. These substances are carried by the blood, and there is ample evidence of the antiparasitic activities of this fluid. Free living, saprophytic forms are destroyed by it, and parasitic forms, even though not necessarily destroyed by it, avoid the blood except when passively carried by it. In disease they crawl along lymph channels, serous membranes, enter joints, or find shelter in injuries. They even inhabit cells for protection. They appear last in the blood in moribund conditions, and their capacity to multiply in it is the function to be suppressed first in artificial immunization.

On the part of the invading organisms there must be some factors which neutralize the normal, antiforeign activities of the host. To some organisms the start is given by an injury which interferes with the normal circulation locally and thus prevents free access of protective forces. Injury probably plays a much larger rôle in the beginnings of infection than is currently granted. It may be exceedingly slight for some infections. Among certain parasites, the injury is inflicted by the parasite itself. In the evolution of the parasitic stage, the parasite to make its way must have possessed certain aggressive destructive functions which are gradually pared down to the required parasitic level. Such agencies to be effective must act in the immediate environment of the parasite to create the needed locus for multiplication.

We have then the metabolism of the parasite and its products in opposition to those of the host. Where do these two groups of forces articulate? What are the substances given off by the parasite which are acted on or neutralized by the normal antiforeign forces, and which among them represent the so-called antigens? What are the normal forces at work not belonging to the antibodies? Evidently a variety of conditions may exist. I wish to call attention to but one. In the evolution of certain parasites the functions of the latter may have developed in such a way as to approach the host's functions more and more, antagonistic processes dropping out. Granted that host reactions are proportional to the alien character of the substances to be digested and assimilated, the approach of the metabolic processes of the parasite to those of the host might eliminate hostile reactions more and more while reducing correspondingly the injurious effects of parasitism on the host. The most advanced parasitism may be conceived as consisting in the direct utilization of host substances as food. That such adaptation is possible is in accord with the marked differences in the behavior of what we call distinctly animal and vegetable parasites. The former, even the very minute, tend to produce prolonged associations with the host, often lasting years, with relatively little destruction of tissues except those cells and structures in which they may develop. The latter are responsible for the acute invasions and more or less sharp decisions in which host or parasite or both may perish. Certain diseases, like tuberculosis, appear to negative this hypothesis as being chronic processes, but the local processes are actually acute and destructive, and the apparent chronicity of the disease is due to the interval elapsing between the series of acute reactions following invasion of new territory.

Illustrations of possible relationships between parasite and host, such as this, suggest the importance of studying special parasitisms since the fundamental processes are to all appearances highly modified and diversified from group to group. We cannot be certain that a given process favors the host or the parasite, since even primarily protective functions may have been modified through natural selection in the presence of parasites into neutral or even parasite-favoring operations. So the process of phagocytosis may be protective, indifferent, or even against the host. In the hatching of the embryo in the digestive tract the parasite makes use of the antiforeign digestive juices of the host to escape from its shell.

Returning to the aggressive and repressive processes active in infectious disease, we may ask whether these are operating simultaneously throughout the disease. On the surface it seems as if most diseases could be divided into a period of infection representing the multiplication of the microbe and a period of subsidence in which certain antibodies appear in quantity. It is, however, probable that the aggressive and defensive activities go together and that what we actually see is a resultant in which one or the other temporarily predominates. If repressive forces are not active from the start, it is difficult to account for the slow multiplication of the parasite and its rapid increase toward the death of the host when the latter has been overpowered. In a few diseases only does the body act like a culture tube. In such cases multiplication in the blood goes on from the beginning. In the rest it is slow, retarded, and gives evidence of steady opposition on the part of the host tissues.

In the attempt to illustrate the supposed diversity in the mechanisms involving the multiplication, inhibition, and discharge of the parasite, we are confronted by the incomplete knowledge of the life history of any parasite or infectious agent within the host. If I, nevertheless, attempt such illustration it is more in the spirit of suggesting problems than of solving them by speculation.

Taking as our first illustration the diphtheria bacillus, we may assume in view of the large amount of work done that this organism's chief weapon is the toxin. When this is neutralized it is checked. The toxin through injury provides a nidus for multiplication. When the antitoxin prevents further injury its food supply is cut off. Having no other means of resisting the host tissues, it remains a surface parasite.

The group coming next in order includes the so-called septic diseases. If we except anthrax, the organisms of septic diseases are as a rule mucous membrane parasites of some host, and the septic effect is usually due to transfer to a fresh susceptible host. In this group the evidence points to a normal antibody to the aggressive, injurious product of the parasite in the blood. The organism gains a foothold through some trauma, and this protects its nidus until it gains the upper hand or is suppressed by the mobilization of more antibodies. Some support is given to this view by Kraus' successful treatment of anthrax with normal cattle serum. The promptness with which antibodies can be set in motion determines whether the local focus is suppressed or widens out into septicemia.

A somewhat higher stage of parasitism is presented by the typhoid and paratyphoid bacilli. While the typhoid bacillus appears to be linked to the human species, the paratyphoid group is represented by a number of serologic varieties whose definite host relations, beyond that of *B. suipestifer* or the hog cholera bacillus, are in doubt. The typhoid bacillus is of special theoretical interest because of the general agreement that a vaccine of killed bacilli establishes a definite resistance to the disease. When we try to formulate what we know of the cycle of this bacillus we find little, if anything, precise in the clinical and pathologic treatises. A priori, two cycles are possible: a simple cycle of limited multiplication in the small intestines, and a cycle beginning with prompt invasion and multiplication in lymphatic structures, discharge through lesions of the same into the intestinal tract. Or the bacilli may primarily multiply in the intestines, and thence, through lesions established there or produced by other parasites, enter the tissues and continue multiplication for a time.

These cycles if adhered to would lead to two types of virulence, one approaching cholera or dysentery, the other producing focal lesions in various tissues and organs. Clinical and epidemiologic data do not exclude the existence of such types. In effect it is probable that the virulence of typhoid bacilli oscillates between the two extremes, now one, now the other predominating, according to environmental and host conditions. If the bacilli multiply at the outset in the small intestines, the infection of the environment would take place early. If discharge depends on ulceration, it would be late. The first type is adapted for extensive infection, at a given time, of water supplies, milk, etc., the second only for immediate contact in unsanitary environment because of the lateness of the discharge and the scarcity of the bacteria given off. The second type would be more virulent, more invasive, and more dangerous to life, and vaccination would appear less successful.

There is little in the immunologic work on record to enable us to interpret the precise relation of the typhoid bacillus to the tissues of the susceptible host. There is an endothelial cell reaction pointed out by Mallory which may also be detected in the lesions of some types of paratyphoid bacilli. The multiplication is a focal one. If more highly specialized types should appear, the focal reaction would approximate that of tuberculosis. Tubercle-like foci sometimes appear in smaller experimental animals. Resistance to the invasive paratyphoid races, like *B. suipestifer* is brought about only after prolonged effort at vaccination.

A parasite standing still higher in its specialized habits is the tubercle bacillus. This organism has been persistently studied for many years, its operation is relatively slow, drawn out as it were, and its activities written in the tissues as are fossil remains in the rocks.

Three races of bacilli, bovine, human, and avian, produce tubercles of similar structure in their respective hosts, but each is practically powerless, with certain exceptions, to do this in the two other hosts. The simplest explanation of this specificity is that each host species has added or subtracted or modified something in the tubercle bacillus or its progenitors to adjust it to its own conditions. Each race in multiplying attracts and stimulates reproduction of endothelial cells. It modifies them to a certain degree. What is the significance of the tubercle? Is it a nest established by the parasite for multiplication, or is it a defensive shutting in by the host? If the tubercle did not form, what would happen to the bacillus? Can it multiply freely in the sinuses of the lymph node where deposited? If we examine the process more closely we shall probably come to the following tentative explanation: The entering tubercle bacillus is carried in some phagocyte into the regional lymph node. Here the bacillus multiplies in the phagocyte, rather than free in the lymph channels. It may be that multiplication in the lymph currents is unfavorable owing to some normal repressive substance in blood and lymph. At the beginning of multiplication, chemotactic substances draw about the bacilli the endothelial elements and perhaps stimulate them and fixed cells to multiply. If the endothelial cells become densely crowded, central necrosis sets in, probably aided by specific products of the bacillus. Rapid necrosis and softening favors extension of the disease by dissemination and new tubercle production elsewhere. The tubercle may thus be said to be protective both to the host and parasite. But the fate of both host and parasite probably depends on what goes on in it, how quickly it is formed, how large it grows, how fragile or resistant the elements.

The metabolic products given off in the tubercle stimulate the production of antibodies. When the bacillus passes out to form a second crop of tubercles, these are less likely to become necrotic owing to an increasing resistance. The bacillus to escape finally to another host must lodge in organs secreting or opening outward. Here partly or wholly released from the control of the circulatory antibodies some races, such as saprophytes, multiply abundantly in mucus, as in many cases of human pulmonary tuberculosis, others rarely, as in the bovine disease in which they are simply thrown out with the disintegrated tubercle masses.

In the attempt to influence the course of such a disease it has been difficult to find a point of attack. Evidently either actual infection with living attenuated bacilli or those measures which raise the normal physiologic capacities of the host to a higher level are theoretically promising, unless analysis goes further and discovers what goes on in the tubercle, what substances pass in and out to influence the tissue reactions, and what significance is to be attached to the vigor or vitality of the cells forming the tubercle.

When we pass to the highly specialized parasites which produce the so-called eruptive diseases of man and animals, limited usually to a single host species, so little is known of the intimate relation of the parasites to the host tissues that illustrations are not available. On the other hand, the highly specialized protozoan parasites whose relations to the host tissues are fairly well known cause little reaction in their environment and complete their cycle with trifling opposition on the part of the host. The mechanisms which on the one hand prevent the host from destroying or suppressing the parasite and on the other check the overmultiplication of the parasite in the vegetative phases, show their existence only occasionally, as it were, by their deficiency. From this group much will be learned in the future that will aid in elucidating the more violent reactions in bacterial infections.

PRACTICAL ASPECTS OF ARTIFICIAL IMMUNIZATION

Perhaps one of the first problems to be forced on the investigator who has successfully identified and cultivated the micro-organism of a given infectious disease is that of providing some preventive treatment, usually in the form of a vaccine. Giving an active immunity and being easily and cheaply provided in large quantities, vaccines always have appealed to those in preventive work, and they will doubtless continue to do so. Before discussing the bearing of theories of susceptibility on vaccinal procedures, it will therefore be advisable to pass in hurried review our practical acquisitions in protective inoculation.

Up to Jenner's time, near the end of the eighteenth century, mankind had learned that lives may be saved by exposing individuals by cohabitation with those having a disease, or by rubbing into mucous membranes the infectious secretions and discharges and thereby producing less severe, less fatal attacks. This mode of protection reached its culmination in smallpox inoculation, which was practiced so extensively in the eighteenth century. At its close Jenner published his brilliant and epoch-making observations on cowpox and demonstrated its protective action against smallpox. The principle involved in cowpox as a vaccine is perhaps the most subtle and elusive of all those which come into play in vaccination. It means the irreversible modification of a virus without any loss of propagative vigor when grafted on another species. Jenner regarded cowpox as coming from an eruptive disease of the horse called "grease." Later it was regarded as a direct derivative of smallpox, rubbed into the cow's udder by the milker. Quite recently de Jong described an eruptive disease among horses which produced on calves and infants typical vaccinia vesicles. If we add to these observations the rare but well supported production of cowpox experimentally with smallpox virus, we are at present justified in assuming that both cowpox and horsepox are producible from smallpox. Such an inference would probably leave all the controversialists of the nineteenth century, were they still alive, amply satisfied. But it would be ungrateful and unfair to recall that small but faithful, persistent, hard-working group of medical men simply as controversialists, who during the latter third of the nineteenth century gave up their lives to the study of smallpox vaccination, introduced the newer ideas from the youthful bacteriology, and protected the method from the attacks of numerous hostile groups whose activities are not yet spent.

In historical order, the next fundamental addition to the principles and technic of protective vaccination was Pasteur's production of so-called attenuated anthrax virus by exposing actively growing cultures to a temperature slightly above that of the human and animal body for a certain number of days. The longer the exposure the weaker the resulting virulence. This lowered virulence was impressed on the entire progeny of the exposed culture. By this means viruses fatal to mice only, to mice and guinea-pigs only, and to mice, guinea-pigs and rabbits, were produced.

The permanent reduction of virulence by heat acting on a growing culture has not been successful with other strains of pathogenic bacteria. The anthrax vaccine thus far stands alone. Before and during Pasteur's work, Toussaint, Chauveau, and others had experimented with heat in the mitigation of anthrax virus. They did not, however, modify their virus, but simply weakened or killed it. During this active period, Chauveau experimented extensively with compressed oxygen and Pasteur's pupils with antiseptics.

Next in order came the demonstration in 1886 by D. E. Salmon and the writer that cultures of certain types of bacteria killed by heat may confer immunity. This demonstration in particular covered only the paratyphoid group.

In his prolonged investigations of rabies and the final production of a successful vaccine, Pasteur made use of the principle underlying the modification of smallpox into cowpox. He had somewhat earlier applied this principle in the making of a vaccine for a bacterial disease of swine, known as rouget, Rotlauf, and swine erysipelas. The bacillus of this disease was passed through a series of pigeons to increase its virulence toward swine and through a series of rabbits to reduce it. The rabbit virus was to be used as a vaccine, the pigeon virus to test the vaccine's efficiency. Owing to the confusion caused by the coexistence of several infectious swine diseases, not recognized at that time, this vaccine could not get a fair trial.

In the vaccination against rabies the virus had been so modified by a long series of passages through rabbits that it may be said to be relatively harmless to man. Added to the precautions represented by this modification is the serial injection of the mitigated virus dried for different periods, the vaccine to be first applied being killed by the drying and thus producing a preliminary immunity similar to that obtained from heated virus.

Following the differentiation of mammalian tubercle bacilli into human and bovine races, Behring and Koch undertook to use the human type to protect cattle from their own type of bacillus. This procedure led to a certain degree of resistance in cattle, but its full value has never been gaged by exhaustive experiments. One of the reasons for abandoning this procedure was the survival of the human bacillus and its appearance in certain rare cases in the milk of cows vaccinated when very young. This incidental result is of no significance to the cow, but the specific use of milk for man would require preliminary pasteurization if this mode of immunization were used. This method of using a closely related living strain of virus on animals relatively immune to it as a vaccine may yet play a prominent part in the struggle against disease both of man and his valuable animals.

One other important factor has been added to those enumerated, namely, the use of specific immune serum with the vaccine. The many animal plagues of diverse character threatening to reduce our valuable food-producing animals to a low level of physical efficiency, if not to wipe them out altogether in time, have tended to stimulate research in the direction of protective vaccines. The first to use immune serum with virus as a vaccine was R. Koch and his coworkers in investigations of rinderpest in South Africa. The immune serum was injected simultaneously with fully virulent blood and tended to restrain the otherwise dangerous vaccine and make its effect similar to that of an attenuated virus.

This so-called simultaneous vaccine was subsequently used with success by de Schweinitz and Dorset in the immunization of swine against the filtrable virus of hog cholera. In this procedure the virus is simply a passage virus maintained in swine and capable, by itself, of setting up severe and fatal disease. Similarly, the attenuated anthrax vaccine of Pasteur has been reinforced by the simultaneous use of a specific immune serum. With this combination Sobernheim was able to use a stronger vaccine than is safe if the culture alone is used.

The next step in the use of serums was the direct mixing of vaccine and specific immune serum. It had been shown that if diphtheria toxin and antitoxin are mixed in such proportions, that a local lesion following the subcutaneous injection is just avoided, an active immunity is nevertheless induced. If the mixture contains enough toxin to produce a local lesion, the active immunity is increased. On the other hand, if the toxin in the mixture is gradually reduced below the neutral point, active immunity is reduced to the vanishing point. By using the passively immunized offspring of guinea-pigs treated with toxin-antitoxin mixtures, I was able to demonstrate the existence of active immunity in the mother as long as she could be kept alive. In 1913 Behring suggested the use of such mixtures for the active immunization of children. Since then William H. Park has made this field his own and made this method of vaccination a practical success. The mixing of living or dead cultures of bacteria with the specific immune serums induced by them in horses has been extensively used by commercial organizations preparing biologic products in the production of so-called sensitized vaccines.

Returning to the earliest practices, the induction of disease by direct inoculation or cohabitation to prevent a more severe spontaneous attack, I wish to call attention to certain practices which involve the introduction of the unmodified virus. In contagious pleuropneumonia of cattle, it has become customary to practice protective inoculation by inserting the fresh virus into the subcutis of the tail. Owing to local conditions and the protective agencies at work to keep the virus from reaching the lungs, the process set up where the virus is deposited leads to immunity.

In another bovine disease, universally prevalent today, in which the placenta of the pregnant cow is the locus of multiplication of the virus, the introduction of the unmitigated virus will produce a high degree of protection provided the virus does not escape into the utero-chorionic space during pregnancy. Strains of this bacillus attenuated merely by artificial growth produce a relatively high resistance if the culture is introduced before gestation begins. The udder in many cases becomes a secondary immunizing focus and tends to prevent the escape of bacteria into the pregnant uterus.

Over and above the use of vaccines to protect against certain dreaded plagues, there have come into use vaccines to mitigate or suppress infectious processes actually under way in the body. Most of the processes to be influenced by this method are chronic parasitisms of skin and mucous membranes.

This brief historical retrospect is chiefly impressive by reason of the variety of methods in use. No two are precisely alike. They are manifestly reflections of differences in the diseases to be combated and may be grouped under three heads.

1. Artificial cultures of living micro-organisms, chiefly bacteria, attenuated in virulence by heat, age, medium, etc., or killed by heat.

2. Virus modified and mitigated by passages through some alien species.

3. Virus presumably maintained as nearly normal as possible by passages through the normal host species and, in the vaccinated animal, kept within control by simultaneous injection of specific antiserums or by introduction into a tissue or region at a distance from the seat of the disease.

In the endeavor on the one hand to illuminate the natural processes of disease from the point of vantage gained by experimental immunization and mass vaccination, and on the other to improve the latter through a rational analysis of the natural process, it is important to bear in mind several limiting conditions.

1. All forces appearing in the course of disease and recovery from infection are present in the normal animal, even though in a relatively inactive state and are capable of being stimulated even to overproduction. The disease or vaccination process does not add anything to the individual, but simply starts a given machinery and mobilizes its products. The individual through vaccination does not acquire any greater capacity for production and mobilization of protective forces and it is well known that to certain individuals the benefit of vaccination is brief and transitory. In practice such individuals would be vaccinated oftener than the average. The maximum possibilities of immunization are, however, definitely fixed by the species characters, as laboratory tests on animals well show.

2. We are in the habit of dealing with parasitism through its clinical manifestations. These are only what may be compared to the visible spectrum. To the infra-red portion may be likened the incubation period, to the continued parasitism after recovery the ultraviolet end, or we may compare it with the frequency curve in which the ordinates represent the clinical disturbances. These begin imperceptibly at one end, increase, and then fade away at the other. Through vaccination the visible spectrum may be eliminated, but not the infra-red or even the ultraviolet end. Thus in typhoid, vaccination may suppress the

tissue invasion but not any intestinal multiplication if the bacillus is sufficiently saprophytic to undergo this process. In smallpox the primary lesion, probably in the respiratory tract, may develop, but its dissemination and final multiplication in the skin may be suppressed. In tuberculosis the primary lesion may start but get no further; or, to describe these occurrences in a more general way, it may be said that if mobilization of the immune bodies is dependent on stimuli, something must happen before they appear. This happening may be the development of some primary lesion after invasion.

Vaccination, then, may be more accurately defined as dividing the impact of a diseases into several milder ones. If the natural resistance to a given infection is already high, vaccination may indeed suppress all further manifestations. There is a similarity between vaccination and the Danysz phenomenon. This tells us that it takes less diphtheria toxin added in successive partial doses to neutralize a given dose of antitoxin than when the latter is neutralized with one dose.

3. Vaccination is administered in the same degree to the normally susceptible, the highly resistant, and the highly susceptible. Are we to assume that the same procedure brings these three classes to the same level of resistance? Naturally not. In the highly susceptible, the natural attack may be so softened that what might have been fatal becomes a more or less regular attack with recovery. If we inoculate a series of mice with a virulent paratyphoid and observe that some die and others either recover or fail to show signs of disease, the difference between these is not due to the inoculation but to the make-up of the mouse. If we inoculate again later those that failed to die, they simply will have a less difficult process to undergo. In certain diseases, the evolution may be postponed by artificial immunization. It will enable the animal, highly susceptible to certain paratyphoid strains, to resist apparently one or a limited number of fatal doses. If such animals are kept long enough after a period of apparent immunity, a slower type of disease develops with greater prominence of the tissue reaction. Eventually death ensues. Tuberculosis may be thus postponed by vaccination and the type of disease slightly altered.

4. In the diseases against which vaccination of one kind or another has been practiced on large numbers, viruses of such high virulence appear from time to time that the usual acquired protection is broken through.

In the host-parasite relationship the identification and correlation of the factors concerned in favoring and suppressing multiplication should be followed by an inquiry as to which of them and to what degree they may be stimulated to increased activity by so-called antigens. Unless they are stimulated to overproduction, some name other than antibodies is called for, and the use of the name antibodies restricted to those which appear in decidedly increased quantities toward the termination of the parasite cycle. From the accumulated literature on immunity we may postulate, I think, that some of the immune forces, notably the antitoxins, are easily stimulated into increased activity, others with difficulty and slowly. There may be others which increase only with the age of the host. Against the rapidly multiplying septic organisms the reaction with immune forces is equally rapid; against others, such as tuberculosis and leprosy, it is increased with difficulty. There may be parasites against which the normal protective forces cannot be increased.

Of the three groups of vaccines mentioned in the foregoing, it is the first made up of living or dead, easily cultivable bacteria, which has absorbed most attention since it presents a large field for exploitation and promises a considerable number of cheap, easily produced vaccines. In this group the micro-organism under artificial cultivation, either under conditions favoring a maximum multiplication or under constraint on account of physical conditions, gradually loses in part what we call virulence, i. e., its capacity to multiply in its established hosts. This partial loss may be due to various changes, in particular the disappearance of those characters which give the organism its distinctive parasitic qualities, aggressive or self-protective. The function of such a vaccine is to multiply just enough to give an impulse to the specific antibacterial forces before being suppressed and destroyed. The easy preparation of different anthrax vaccines by different periods of exposure to a dysgenetic temperature, leading to such vaccines as mouse anthrax, guinea-pig anthrax, rabbit and sheep anthrax, has given to the whole procedure an air of simplicity which it really lacks. Epoch-making discoveries usually happen through a combination of industry, accident, and the rare capacity to seize on the fleeting apparition of success. So it was with anthrax in the hands of Pasteur. No other vaccine has given such definite results.

Between highly attenuated living bacteria and those killed by the lowest sterilizing temperature there is only a slight difference. It is quite possible that living vaccines can be prepared of such feeble resistance that once introduced into the tissues none multiply. In the preparation of vaccines killed by heat or other agents, the first question to present itself is the significance of the factor of virulence in the cultures used. Should the organism possess as nearly as possible its normal parasitic functions, or should it be attenuated? If the body in its attempt to rid itself of parasitic invaders must meet all aggressive and defensive forces of the parasite, we should say unqualifiedly that the vaccine should consist only of highly invasive organisms, suitably killed. If, on the other hand, there are only certain activities, certain products of the microbe that must be attacked by the host to promote resistance, all others in the vaccine would be a hindrance.

It has been stated from time to time that highly virulent strains of cholera, bubonic plague, and typhoid, used as vaccine after they have been killed by heat or chloroform, are too toxic for use. It may be questioned in answer to these objections to virulent strains whether too large doses were not used and whether minute doses of virulent strains would not accomplish what large doses of nonvirulent strains are expected to do. In future more precise studies of specific vaccines, the quantitative aspect will need attention. Hitherto gross, qualitative differences have been aimed at. In fact, in the use of killed bacteria practice has outrun experimental analysis, as has been so common in medicine.

It would seem relatively easy to demonstrate the action of vaccines on animals, but this is not true. Infectious diseases which have become definitely established among animals induce disease in only a certain variable percentage of the animals exposed, and the attack varies much chronologically. Here also large numbers of cases are indicated if the result is to take any definite shape. Hitherto little interest has been developed in this field, partly because animal diseases had not been studied, partly because it was difficult to anticipate whether inferences based on such studies would be accepted as holding true for related infectious processes in the human subject. Human medicine has been capricious in this respect, for it has swallowed avidly many conclusions and inferences based on analogy and entirely ignored or denied the validity of others of equal or better repute as scientific data. In general, it may be stated that bacteria killed by heat have not as yet proved successful in animal diseases. Pasteur tried them in anthrax and failed, as Duclaux tells us. Although they may give rise to a relatively high concentration of agglutinins, the actual protection afforded is slight. This has been found true in experimental paratyphoid when the races vaccinated against have distinctly invasive characters. The method, however, deserves continued trial since diseases caused by certain groups of bacteria, such as the bipolar bacteria, are distinctly influenced by vaccines made from heated cultures. The agglutinin titer, however, hardly represents more than that a certain number of bacteria bodies have passed through the host organism, and it should not be interpreted necessarily as increased resistance. The generally accepted effect of heated cultures of typhoid bacilli in protecting against typhoid is not doubted. It should, however, stimulate further inquiry into the nature of the disease to discover how such an effect is explainable. It is highly probable that the human race is already well protected against this highly saprophytic organism and a slight impulse may be sufficient to ward off invasion, not so much of the intestinal tract and multiplication there, as of subsequent entry and multiplication in the lymphatic tissues.

The use of heated cultures has now been advanced into the therapeutic field. There is no good reason to assume that the principles governing prophylactic and therapeutic application are essentially different. For the rational application of such vaccines an exact knowledge of the processes of infection and recovery is far more urgent than in preventive vaccination, for there is danger of doing injury. The important problem is the elimination, if possible, from the vaccine of all factors not immediately concerned in the curative reaction. In the nature of things such elimination may remain a pious hope, but it is essential that the effort be made.

Another most important development of clinical medicine to all appearances not in harmony with current theories of resistance and how it is acquired, is the tendency to eliminate all superficial, local foci of infection as dangerous to the individual. Local foci probably, from time to time, give off agents into the circulation. These, however, are presumably kept in check by the influence of the local process. When such a focus is removed and agents still disseminated in the body, are they more or less dangerous than before? Obviously a number of conditions enter into this problem, which need more experimental study before either clinical medicine or immunology may speak the last word.

There remains to be considered the effect of general immunization on the race as a whole. In the unrestricted interplay of natural forces among animals, disease has little chance of gaining a foothold because the animal must possess a certain degree of strength, instinct, and native skill to survive. This is true of solitary as well as gregarious animals. In the human race, the formation of groups and the capacity of the group to protect itself within limits from natural enemies leads to the survival of large numbers of what might be called inferior varieties and the permanent domiciling of various types of disease in such populations. Through the intermingling of types of widely different geographic and climatic origins various degrees of susceptibility to parasitism prevail. There are those at one end that are fatally susceptible, at the other markedly resistant. In between are degrees of resistance and susceptibility. These varieties, if plotted, would probably give us a normal frequency curve of the usual type. The relative susceptibilities on the part of the host species and the activity of the virus or the parasites maintain themselves subject to fluctuations in the environment, through the continual appearance of spontaneous variations on the part of the hosts and the continual adjustment to these on the part of the parasite.

To this self-regulating reaction between host and parasite which tends automatically to eliminate all those individuals near one end of the negative side of the mean, we apply a protective vaccine. What will be the result? The answer to this question cannot be given on the basis of any experience possessed by the human race concerning itself or its domesticated animals. Although vaccination against smallpox has been quite generally practiced for half a century, the measures for preventing the dissemination of the virus through isolation and quarantine have been more rigorously applied than vaccination itself. Moreover, it is a disease quite readily recognized in its early stages and there are presumably no healthy carriers. Evidently largely conceived and thoroughly executed experiments on different types of infectious animal diseases must provide fundamental data for the solution of our question.

Concerning the results of immunization with dead typhoid bacilli, the time is still too short to yield any general inferences of definite value. The general application of a successful vaccine in this disease should at first lead to a distinct lowering of morbidity and mortality. If the same methods of disinfection of discharges obtain as are now current, and if the great communal streams of milk and water are supervised to prevent undue pollution, we should expect, after several generations, the appearance of variants having less as well as more resistance. This would be registered by a wave of higher morbidity and mortality in spite of the vaccination. Such waves might be expected periodically even with generally applied vaccination. By such reasoning we may account for the difficulty of depressing diphtheria mortality below a certain level and the occasional appearance of epidemic waves. The gist of the matter is that though the plane of resistance is raised, the same phenomena will go on on this higher plane as were witnessed before vaccination. The one practical argument which emerges from such analysis is that any efficient vaccination once in operation must be generally applied, and it cannot be discontinued without a simultaneous higher morbidity and mortality for one or more generations. The important problems caused by the general use of a vaccine, such as the appearance of modified types of disease, the relative increase or decrease of so-called carriers and the possible appearance of modified races of bacilli, can only be solved by cooperation on a large scale.

Perhaps the greatest benefit which vaccination might confer on the human race would be a lightening of the enormous and increasing burden of trying to intercept too thoroughly the streams of infection. The generation just passed has witnessed the application, on a huge scale, of methods intended to stop these streams. They have been applied by continent against continent, state against state, community against community, and individual against individual. They are responsible for a great costly public health machinery and for numerous daily restrictions in the life of the individual. The need for restricting and suppressing wherever possible the currents of infection will continue in order that the increasing danger of a growing population may be met. It is safe to say that the machinery set up for this purpose by public health agencies cannot check completely any stream of infection. Its success is quantitative rather than qualitative. It keeps the dose of infection down and reduces its frequency. We may take courage from the fact that in a population in which a given disease has prevailed for some time, a small dose of certain viruses may produce little disturbance while it immunizes toward a future possibly larger dose. There is, therefore, going on constantly some protective inoculation of which we are usually quite unaware. This factor, the destruction of virus in the patient's environment, and what vaccination is practiced constitute the triumvirate which is endeavoring to keep parasitism within safe limits. It cannot be wholly eliminated for it involves a universal activity of life itself. A most important final problem bearing on the best interests of the race itself is for us to learn how far to go in the destruction of parasitism and how much to sacrifice to this end.

In presenting to you from a comparative, biologic standpoint methods of protective inoculation, whether or not such methods could be used today on the human being, I have had two reasons. In the first place, the illustrious scientist in whose name you have established a foundation lecture to stimulate research had no conventions as to the nature of the material on which to test his scientific intuitions. His medical work, on which much of his fame rests, was done on diseases of animals and essentially those species which were useful to his fellow men. Throughout his career he attacked practical problems.

The second reason for dealing with immunization from a more general standpoint than that afforded by practices in human medicine is the possibility that in the future either through urgency or because of better methods, living vaccines may be used on human beings to mitigate the blow of diseases that tend to break through all barriers put in their way. Medicine should be prepared, through as thorough an understanding of disease processes as the progress of science affords, to evaluate the virtues and defects of all methods aiming at the same final result and thus be ready to apply them when the need presents itself.

FAULTY FOOD IN RELATION TO GASTRO-INTESTINAL DISORDER

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I propose in this lecture to propound the thesis that much of the gastro-intestinal disorder of civilized peoples at the present day is due to faulty food. In doing so I shall present evidence of the incidence of such disorder among civilized communities and of its comparative absence among certain races living under more natural conditions; and contrast, in general terms, the food habits of the former with those of the latter. I shall refer to the special relation of perfect food to the functional perfection of the gastro-intestinal tract; and from these sources advance presumptive evidence of the effects of faulty food in impairing the functional perfection of the digestive system. Experimental evidence of these effects will then be given, and attention directed to the applicability of the experimental results to the genesis of certain acute and chronic gastro-intestinal disorders. Finally, I shall argue that faulty foods capable of causing similar effects in man to those produced experimentally in animals are widely made use of at the present day. Having thus introduced the subject to your notice I shall leave you to examine for yourselves in the wards, the clinic and the home the truth of the doctrine I have propounded.

PREVALENCE OF GASTRO-INTESTINAL DISORDERS AMONG CIVILIZED PEOPLES

It was recently stated by a public health administrator in England that 25 per cent. of all patients seeking relief at our clinics did so for gastro-intestinal disorders. So far as my memory serves me, the statement was made in order to emphasize the necessity for a study of the etiologic factors concerned in the production of this great mass of sickness. It has, too, been pointed out within the last few months that the alarming increase of cancer among town-dwellers in Great Britain is due, in the main, to the increasing prevalence of gastro-intestinal cancer. These are facts of such public concern that they demand the close attention of all students of public health; for if by any means we can prevent gastro-intestinal disorders we shall relieve civilized communities of one quarter of their sufferings.

In the fascinating pursuit of pathogenic organisms as causes of disease, we are apt to overlook the claims on our consideration of sufferers from noninfectious maladies—the claims, for instance, of the dyspeptic or of the sufferer from colonic disease. Possiby this is due to the fact that the dyspeptic rarely dies of dyspepsia nor the subject of colonic disease from colitis. Their discomforts, not being catching, are no more to their neighbors than a source of irritation; consequently their claims on the consideration of the hygienist are overshadowed by the multitude's demand for the elimination of the microbe. The multitude does not know, and we ourselves often forget, that the activities of the microbe as a pathogenic agent are very often dependent on those very conditions of life which give rise to the discomforts and sufferings of the victims of such maladies as indigestion and mucomembranous colitis. It is these conditions of life and of imperfect nutrition which frequently prepare the soil of the body for the rank growth of bacterial agents.

Fortunately, within the last few years the attention of investigators of disease has been directed into new channels of inquiry, channels which take cognizance of the influence of negative factors in the production of disease as well as of positive factors. As is usual in any new development, advance has been made along narrow lines; but the stream of knowledge has gradually broadened, so that we are beginning to appreciate the wider significance of the negative factors in the production of disease in general. Chief among them is food deficient in some ingredient essential to the body's well-being, such, for instance, as vitamins, suitable protein, iodin, phosphorus or calcium. It sometimes happens that one such essential is present in the food in insufficient quantity. Then metabolic harmony ceases or becomes discordant and "deficiency disease" results.

It is necessary to emphasize that "deficiency disease" is a question not merely of deficiency of vitamins, but of deficiency of any essential requisite of a perfect food. Nor is this all, for in practice deficiency of one essential often means excess of another; such, for instance, as relative deficiency of vitamin B in the presence of an excess of starch, or relative deficiency of iodin in the presence of an excess of fats; the excesses may themselves give rise to relative deficiencies of other essentials, and especially of those present in the food in relatively small quantities. Lack of balance of the food is a fault second only in importance to actual want of some essential ingredient. The food faults encountered in practice are thus often compounded of deficiencies in association with excesses.

The importance of adequate food-balance is illustrated by even the purest of "deficiency diseases," such as scurvy, concerning which Pitz and Lewis have shown that adequate provision of other food essentials will delay in guinea-pigs the onset of scurvy, induced by lack of vitamin C, and prolong their life. The same is true of other deficiency diseases, such as polyneuritis columbarum induced by lack of vitamin B. My own researches have impressed the importance of perfect food balance on me with increasing force within the last few months, since I have been able to show that an excess of fats or of unsaturated oleic acid in the food may cause a relative deficiency of iodin and enlargement of the thyroid gland (goiter). It is necessary also, in this connection, to recognize a further fact, namely, that one cannot in practice dissociate from the effects of deficient and ill-balanced foods those of bacterial or protozoal agencies whose ravages have been made possible by the faulty food. My remarks today, therefore, are to be considered from these broader aspects, namely, of food deficiencies in association with food excesses, and with the fortuitous intervention of microbic or other pathogenic organisms.

FREEDOM OF UNCIVILIZED RACES FROM GASTRO-INTESTINAL DISTURBANCES

In considering gastro-intestinal disease in the mass, the realization is forced on one that since it is so common it must have a very common cause. It is helpful, in endeavoring to ascertain the cause of a malady widely prevalent in one community or race, to contrast the conditions of life of such a community with those of another that is free, or comparatively free, from the malady in question. My own experiences have afforded me this opportunity in the case of gastro-intestinal disorders. For some nine years of my professional life my duties lay in a remote part of the Himalayas where there are located several isolated races far removed from the refinements of civilization. Certain of these races are of magnificent physique, preserving until late in life the characters of youth; they are usually fertile and long lived, and endowed with nervous systems of notable stability. Their longevity and fertility were, in the case of one of them, matters of such concern to the ruling chief that he took me to task for what he considered to be my ridiculous eagerness to prolong the lives of the ancients of his people, among whom were many of my patients. The operation for senile cataract appeared to him a waste of my economic opportunities, and he tentatively suggested instead the introduction of some form of lethal chamber designed to remove from his realms those who by reason of their age and infirmity were no longer of use to the community. Among another of these races, the custom which required an eldest son on pain of death to carry in a conical basket his aged and decrepit parents to the top of a high rock from which to hurl them to destruction has died out only within recent years under the protective influence of British rule; and the proverb "Everyman's basket for his son" still survives the custom.

During the period of my association with these peoples I never saw a case of asthenic dyspepsia, of gastric or duodenal ulcer, of appendicitis, of mucous colitis, or of cancer, although my operating list averaged 400 major operations a year. While I cannot aver that all these maladies were quite unknown, I have the strongest reason for the assertion that they were remarkably infrequent. The occasions on which my attention was directed to the abdominal viscera of these people were of the rarest. I can, as I write, recall most of them; occasions when my assistance was called for in the relief of strangulated hernias, or to expel the ubiquitous parasite Ascaris lumbricoides. Among these people the "abdomen oversensitive" to nerve impressions, to fatigue, anxiety or cold was unknown. Their consciousness of the existence of this part of their anatomy was, as a rule, related solely to the sensation of hunger. Indeed, their buoyant abdominal health has, since my return to the West, provided a remarkable contrast with the dyspeptic and colonic lamentations of our highly civilized communities. Searching for an explanation of this difference in incidence of gastro-intestinal disease in the two peoples, I find it, in the main, in four circumstances: (1) Infants are reared as Nature intended them to be reared—at the breast. If this source of nourishment fails, they die; and at least they are spared the future gastro-intestinal miseries which so often have their origin in the first bottle. (2) The people live on the unsophisticated foods of Nature: milk, eggs, grains, fruit and vegetables. I don't suppose that one in every thousand of them has ever seen a tinned salmon, a chocolate or a patent infant food, nor that as much sugar is imported into their country in a year as is used in a moderately sized hotel of this city in a single day. (3) Their religion prohibits alcohol, and although they do not always lead in this respect a strictly religious life, nevertheless they are eminently a teetotal race. (4) Their manner of life requires the vigorous exercise of their bodies.

FAULTY FOOD

Each one of these differences in the habits of my Himalayan friends, as compared with those of Western peoples, would form, in itself, a fitting subject for discourse; but I shall content myself with a brief consideration of the first two under the general heading of "faulty food." It is not that the races to which I have referred live under hygienic conditions superior, as to housing and conservancy, to those of the masses in the West. On the contrary, in both these respects their conditions of life are most primitive. Nor is it that in their agricultural struggles with Nature they have acquired any peculiar immunity to the effects of faulty food; they are, indeed, as susceptible as others to these effects, as the following occurrence illustrates: It fell out that the cultivable lands of one of these races were no longer sufficiently extensive for the increasing population. To meet this it was decided to colonize another tract which had never previously been cultivated. A dozen families were settled there, and they made shift to grow upon its granite and infertile soil such grains as they could. My attention was directed to their efforts, and more especially to the results of them, when ten out of twelve adult young men developed paralysis of the lower limbs due to lathyrism—a rare malady resulting from the disproportionate use in the food of the vetch Lathyrus sativus. These settlers, finding it impossible to grow a sufficiency of wheat, had cultivated the hardy vetch and used it in too high admixture with their scanty stores of wheat. The result was the development of paralysis of the lower limbs among the male population, while the female members of the settlement were unaffected. I mention this dramatic occurrence to show you that perfect physique and stability of the nervous system did not protect them from the effects of faulty food, and incidentally to emphasize the sex variations to be found in maladies resulting from food faults. For although in the case of lathyrism the difference in incidence of the disease in the two sexes is more marked than in any other nutritional malady known to me, yet it is in some nutritional diseases a very striking feature.

We see, then, that as exemplified by certain Himalayan races and, as I find from recent reports in the medical press, by such races as those of upper Egypt and northern Nigeria, enforced restriction to the unsophisticated foodstuffs of Nature is compatible with fertility, long life, continued vigor, perfect physique and a remarkable freedom from digestive and gastro-intestinal disorders, and from cancer. I must confess that with these examples before me I find myself in accord with Hindhede, who affirms—and on unequivocal evidence—that the two chief causes of disease and death are food and drink.

CONTRAST BETWEEN FOOD HABITS OF PRIMITIVE PEOPLES AND THOSE OF CIVILIZED COMMUNITIES

Let us now for a moment contrast the habits of these primitive peoples in respect to food with those of our more highly civilized communities. The former are content with natural foods: milk, eggs, grains, fruits and leafy vegetables—or, if their state of mind be not precisely one of contentment, they can at least not better their lot nor worsen it. These natural foods—"the protective foods," as McCollum has named them—provide in proper quality and proportion the proximate principles and vitamins necessary for nutritional harmony, and the proper vegetable residues for the healthy evacuation of the bowels. But the case is different with civilized man. No longer is he content with the unsophisticated foods made in Nature's laboratory, with "herbs bearing seed" and with "every tree in which is the fruit of a tree yielding seed." To him these are "still for meat," but preserved, purified, polished, pickled and canned. Some he extracts and distils with the object of procuring concentrates agreeable to his taste. His animal food he heats, dries, freezes, thaws and stores. One way or another by desiccation, by chemicals, by heating, by freezing and thawing, by oxidation and decomposition, by milling and polishing, he applies the principles of his civilization—the elimination of the natural and the substitution of the artificial—to the food he eats and the fluids he drinks. With such skill does he do so that he often converts his food into a "dead" fuel mass, devoid of those vitamins which are to it as the magneto's spark to the fuel mixture of a petrol-driven engine. Unmindful, too, or more often ignorant, of the composition of the fuel-mixture with which he charges his human machine, he joins deficiencies of some essentials with excesses of others, heedless that the smooth running of his bodily functions bears intimate relation to the ordered balance of these essentials.

I am not at the moment concerned with the circumstances of his civilization—expediency, penury, prejudice, ignorance or habit—which have compelled man into this dangerous course. It is sufficient for my purpose that these circumstances exist, and that, in consequence of the food habits they have fostered, normal bodily function cannot be sustained and gastro-intestinal function is one of the first to suffer. Let me emphasize this point: "Gastro-intestinal function is one of the first to suffer." This truth is made manifest by the clinical evidences of disease that are first to appear in wild monkeys fed on deficient and ill-balanced food: loss of appetite, depraved appetite, vomiting, diarrhea, dysentery, anemia, unhealthy skin, asthenia, and loss of body-weight. If the faulty food be persisted in, other symptoms manifest themselves later, due in the main to malnutrition of the central nervous system; but it is the gastro-intestinal tract, the functions of digestion, absorption and assimilation that are among the first to fail in consequence of faulty food. These are the signs that our ship is running upon the rocks and, as good pilots, we must be aware of them. I often think that we are apt to assume more readily the office of salvors of wrecks than of pilots whose function it is to prevent them.

But not only is functional failure of the digestive system an early evidence of faulty food, but the gastro-intestinal tract is often the first to exhibit clinical evidence of infection by pathogenic organisms in consequence of it. Let me illustrate this last point by an experience in my own laboratory: Thirty-six wild monkeys were captured in the jungles of Madras and transported with the least possible delay to my laboratory in the hills at Coonor. They were in perfect health and full of vigor—wild things usually are. I had in these animals perfectly normal tissues to work on: a unique opportunity to observe the first clinical and pathologic effects on normal tissues of the agent —faulty food—with which I was working. Each of these animals was placed in a separate cage, and all were confined in the same animal room. One attendant looked after them all. Twelve of them were fed on natural food, the remaining twenty-four on food deficient in some cases in vitamins as well as ill balanced; others were fed on natural food in which the living essences had been destroyed by sterilization. Those that were naturally fed remained free from intestinal disease; those that were fed on deficient and ill-balanced food and on sterilized food developed, within a short time in the majority of cases, diarrhea or actual dysentery. Here, then, is an unequivocal instance not only of the effect of faulty food in inducing a specific disease such as dysentery but of the protection against it that is afforded by a natural and well-balanced food.

RELATION OF PERFECT FOOD TO FUNCTIONAL PERFECTION OF GASTRO-INTESTINAL TRACT

Now let us consider for a moment the purposes which perfect food subserves. Every one recognizes that food is taken into the body to repair tissue waste, to supply energy, and to provide the proper medium for the chemical reactions of the body. But do we always visualize these functions of food in relation to the organs of digestion themselves, and to the work to be done by the gastro-intestinal tract? If we did, I think we should have no difficulty in realizing the special effects on these organs of an insufficient supply of proteins which rebuild the digestive tissues and make good their waste, or of those constituents of the food which supply energy for the production of the digestive secretions and the movements of food along the digestive tract, or of salts which provide the proper medium for the chemical processes of digestion, or of vitamins which activate the cells of the digestive system to healthy function. The effects of deficiency of these essentials must of necessity be manifested in failures of digestive, absorptive, assimilative and motor functions of this important region of the body. It is not necessary to make laboratory experiments to prove that if a woman lives on white bread, margarin, condensed milk and tea with a minimum of imported meat and boiled potatoes she is prone to suffer from such digestive disorders as dyspepsia and colonic disease. For such a diet does not contain a sufficiency of proteins to rebuild the tissues involved in digestion, assimilation and evacuation of the bowel contents; it does not contain a sufficiency of vitamin to activate the cells of the digestive system to healthy function; it is ill balanced, and by its excessive richness in starch it favors the development in the digestive tract of fermentative organisms, and makes relatively more deficient the vitamins necessary to healthy cellular action; nor does it contain a sufficiency of vegetable residue, of cellulose, waxes and vegetable salts, to insure natural action of the bowels.

EFFECTS OF FAULTY FOOD

Nor do we, I think, always consider the dependence of one constituent of the food upon another for its share in the maintenance of nutritional harmony. We know that if such essentials as protein and inorganic salts be not provided in adequate quality and quantity, growth must flag and repair of body waste must fail or cease; but do we realize that the utilization of suitable protein and of suitable salts is dependent on the presence in the food of a sufficiency of vitamins, or that the efficiency of vitamins is dependent in considerable measure on the adequate supply of these proximate principles? If the tissue waste of the gastro-intestinal tract be not made good—whether in consequence of insufficient supply of suitable protein or of its insufficient utilization—then must the production of digestive juices fail, the mechanism of absorption and assimilation flag, the neuromuscular control of the gastro-intestinal tract become inefficient and the tissues of the tract become the prey of pathogenic organisms. It is thus that such a nutritional disease as pellagra arises, and thus that the manifold varieties of gastro-intestinal disorder due to failure of digestive function may come into being.

It is unwise to consider any of the essential ingredients of food, whether proteins, carbohydrates, fats, salts, water or vitamins, as independent of the assistance derivable from their associates in the maintenance of digestive and nutritional harmony. No doubt, some of these have special relations to others, as for instance that of iodin to fats, that of vitamin B to carbohydrates, that of vitamin A to lipoids, calcium and phosphorus holding substances, and that of vitamin C to inorganic salts. But whatever be their special relations one to another they are all links in the chain of essential substances requisite for the harmonious regulation of life's processes: if one link be broken, the harmony ceases or becomes discord. Of late the science of nutrition has tended to assume a too "vitaminic" outlook, and it is well to realize that, important as these substances are, man cannot live on vitamins alone, nor can he live on proximate principles alone: each is complemental to the other, and deprivation of the one leads to starvation as surely as does deprivation of the other. Our knowledge of vitamins is still in the making, but it serves a useful purpose to have some mental conception of their function. I have likened it to the magneto's spark which ignites the fuel-mixture of a petrol-driven engine, liberating its energy: the spark is of no use without the fuel nor the fuel without the spark; nay, more, the efficacy of the spark is dependent in great measure on the composition of the fuel-mixture.

EVIDENCE OF THESE EFFECTS

But if I am to succeed in demonstrating the truth of my claim that faulty food is responsible for much of the gastro-intestinal ill health so common at the present day, I must provide other than presumptive evidence of its effects on the digestive system and convince you also that foods having faults capable of causing these effects are nowadays extensively used by civilized communities. I propose, therefore, to fulfil the first condition by ocular demonstration and to rely upon my argument for the fulfilment of the second.

For some years past I have been engaged in a study of the effects of deficient and ill-balanced food on the various organs and tissues of the body, as observable in animals fed on such foods under experimental conditions. Having reached certain conclusions with respect to the digestive organs and gastro-intestinal tract in such animals as pigeons, rats and guinea-pigs, I repeated my experiments in wild monkeys captured in the jungles of Madras so that I might observe the effects of faulty foods on animals closely related to man. The foods I used were natural foods that had been rendered faulty by various means; they were of several classes:

1. Foods deficient in all three classes of vitamins, in suitable protein, in fats and excessively rich in starch.
2. Foods deficient in vitamins B and C and excessively rich in starch and fats.
3. Foods deficient in vitamin C only, in vitamin B only, and in vitamins A and B, but well balanced in other respects.

These classes of food presented for my purpose an adequate range of deficiencies alone, and of deficiencies in combination with excesses; they include many of the food faults observable in the dietary of many civilized people at the present day. Before demonstrating the effects of these faulty foods on the digestive organs and gastro-intestinal tract, I must point out very shortly the simultaneous effects to which they give rise on the endocrine regulators of metabolism, the thyroid gland, the suprarenal gland, and the pituitary body; for it is to be remembered that the maintenance of healthy gastro-intestinal function is dependent in considerable measure on healthy endocrine action. It would carry me too far afield to develop adequately the latter theme: I content myself, therefore, with directing your attention to it, and with laying emphasis on the fact that it is necessary to consider in relation to the changes produced in the digestive system by faulty food those that are simultaneously produced by the same agency in the endocrine system. As an instance of this intimate correlation of digestive and endocrine function and disorder, I may refer to the simultaneous production by faulty food of colitis, of depreciation of liver function, and of suprarenal derangement. The first is the most obvious clinical feature of the nutritional disturbance induced by the faulty food; the occurrence of the second may serve to account for the toxic symptoms from which the sufferers from mucous colitis suffer, and for the opinion held by some that mucous colitis is due to hepatic insufficiency; while the third provides some insight into the effects of fatigue, anxiety and cold in precipitating attacks of mucous colitis in the malnourished subjects of colonic disease. The malady is, indeed, as much a disorder of the suprarenal glands as of the colon.

The data afforded by specimens indicate that the profound changes resulting in the gastro-intestinal tract in consequence of the various deficient foods employed are similar in kind in the three species of animals I used—pigeons, guinea-pigs and monkeys; it may be expected, therefore, that they will be similar in kind, if not in degree, in human beings whose dietaries have faults similar in kind if not in degree to those used in the experiments. I think there is good reason to believe that the prolonged use of a moderately faulty food will lead to them as certainly as the less prolonged use of a more faulty food. Without attempting to analyze them too closely or to attribute to each fault a specific effect we may, I think, draw from them certain broad conclusions:

1. The health of the gastro-intestinal tract is dependent on an adequate provision of vitamins. The absence of growth vitamins is capable of producing pathologic changes in the tract which frequently assume the clinical form of colitis. This observation is of the highest importance in view of the frequency with which this malady is encountered at the present day. Deficiency of vitamin C is especially concerned in the production of congestive and hemorrhagic lesions in the tract, and evidences of these may be found in animals which have not exhibited during life any of the clinical manifestations of scurvy in noteworthy degree. A state of ill health of the gastro-intestinal tract may thus be a prescorbutic manifestation of disease due to insufficiency of this vitamin, especially when associated with an excess of starch or fat or both in the food.

2. The disorder of the gastro-intestinal tract consequent on vitamin deficiency is enhanced when the food is ill balanced.

3. The pathologic processes resulting in this situation from deficient and ill-balanced foods are:

(a) Congestive, necrotic and inflammatory changes in the mucous membrane, sometimes involving the entire tract, sometimes limited areas of it.

(b) Degenerative changes in the neuromuscular mechanism of the tract, tending to dilatation of the stomach, ballooning of areas of small and large bowel, and probably also to intussusception.

(c) Degenerative changes in the secretory elements of the tract—of the gastric glands, the pyloric glands, the glands of Brunner, the glands of Lieberkühn, and the mucous glands of the colon. These changes are such as must cause grave derangement of digestive and assimilative processes.

(d) Toxic absorption from the diseased bowel, as evidenced by changes in the mesenteric glands.

(e) Impairment of the protective resources of the gastro-intestinal mucosa against infecting agents, due to hemorrhagic infiltration, to atrophy of the lymphoid cells, and to imperfect production of gastro-intestinal juices. This impairment not only results in infections of the mucous membrane itself, but also permits of the passage into the blood stream of micro-organisms from the bowel.

(f) It is to be emphasized that the pathologic changes found in the gastro-intestinal tract are more marked in some individuals than in others; and that, while all of them may occur in one and the same subject, it is usual to find considerable variation in the incidence of particular lesions in different individuals.

APPLICABILITY OF EXPERIMENTAL RESULTS TO GENESIS OF GASTRO-INTESTINAL DISORDERS

With these evidences of the effects of faulty food before us, we have, I think, good reason to proceed with our investigation of the relation of faulty food to the common gastro-intestinal disorders of the present day.

It is usually accepted as a proof of the causation of a malady that if an investigator by one agency or another can produce in animals, under controlled experimental condition, the malady in question, then this agency is the cause of the disease, or intimately associated with its causation. Consider, then, that by means of faulty food, (1) diarrhea, (2) dysentery, (3) dyspepsia and gastric dilatation, (4) gastric and duodenal ulcer, (5) intussusception, (6) colitis and (7) failure of the colonic function can be produced experimentally. I do not argue that they are invariably so produced or that faulty food is the only cause of them. I do not deny the influence of microbic or other pathogenic agents in contributing to their production; indeed, I have ever insisted upon it. But I do maintain that faulty food is often at the bottom of their causation, and that the use of natural or well-balanced food from birth onward will greatly militate against their occurrence.

I cannot remember that by means other than faulty food such a disorder as colitis can be so readily produced, if at all; for the experimental production of amebic dysentery by the oral administration of Endameba histolytica cysts is not at all convincing. On the other hand, I have seen amebic dysentery arise in deficiently fed wild monkeys, while others that were well fed escaped the disease although subjected to the same risks of infection. In this instance, malnutrition had enabled the specific organism to implant itself in the tissues of the bowel. If further evidence of the influence of faulty food in the production of these gastro-intestinal disorders be needed, it will be found in abundance in the medical history of the late war, during which these disorders were so often the consequence of faulty food. In this regard, our enemies have served unwittingly one useful purpose: they forced us to concentrate attention on the immediate and remote effects of food faults on the human body. But our ever present enemies in peace—poverty, prejudice, ignorance, habit—are no less responsible in this regard; they, too, beneath the vaunted culture of our civilization, inflict upon numbers of our people an intolerable load of misery, which it is our duty to relieve.

I would, therefore, urge on your attention a consideration of the effects of faulty food in relation to such acute disorders as infantile diarrhea, jail dysentery and asylum dysentery, asking you, while remembering the bacteriologic aspects of these maladies, to look on them also from the point of view of faulty food. The bacteriologic path has led us far in our knowledge of preventable disease, but it will lead us further still if we traverse at the same time the paths of malnutrition that so often run parallel with it. In relation to such chronic disorders as "mucous disease" in children, chronic gastro-intestinal dyspepsia, pellagra sine pellagra, colonic disease in adults, celiac disease, gastric and duodenal ulcer, and chronic intestinal stasis, the food factor in their production deserves the fullest consideration; for if the facts I have laid before you do not provide the whole explanation of their genesis, they are, I am convinced, intimately related to it. Time does not permit me to develop this theme further. Full reference has been made to it in my recently published book, "Studies in Deficiency Disease," where many points which of necessity I have omitted from this lecture are set out.

EXTENSIVE USE OF FAULTY FOOD

Turning now to my last duty, that of presenting evidence that faulty food is largely used by many civilized people at the present day, I would ask you to consider first in this connection the increasing tendency in modern times to rear infants artificially—on boiled, pasteurized and dried milks, and on proprietary foods which are all of them vastly inferior to the healthy mother's milk in substances essential to the well-being of the child—inferior not only in vitamins, but also in enzymes, thyroid derivatives and other essentials. When, as is sometimes the case, mother's milk is itself harmful to the child, is not this largely the result of her own disordered metabolism that in many cases results from improper feeding before, during and after pregnancy? For mother's milk may, like the milk of animals, be deficient in certain respects if her food be deficient. The milk of stall fed cows is not so rich either in vitamin A or in vitamin C as that of cows fed in green pastures.

Again, is not cow's milk—an important dietary constituent of young and old alike—gradually becoming a luxury reserved for the few? Vegetable margarins are replacing butter even among the richer classes. Fresh fruit, certainly in Great Britain, is a comparative rarity, even on the tables of the rich. Green vegetables are scanty, and such as there are are often cooked to the point of almost complete extraction of their vitamins and salts. White bread has largely replaced whole-meal bread, and it is notorious that bread forms a high proportion of the dietaries of persons of limited means. It is notable that, despite the food restrictions imposed upon the people of Belgium during the late war, the infant mortality and infantile diarrhea decreased greatly—a circumstance which was due to the organized propaganda encouraging mothers to nurse their infants, and to the establishment of national canteens which provided prospective mothers from the fifth month of pregnancy onward with eggs, meat, milk and vegetables. Again, fresh eggs are so expensive as to debar the masses from their use. Meat is at best but poor in vitamins, and its value in these essentials is not enhanced by freezing and thawing. Sugar is consumed in quantities unheard of a century ago, and sugar is devoid of vitamins which the cane juice originally contained. The use of stale foods involving the introduction of factors incidental to oxidation and putrefaction is the rule; that of fresh foods, the exception.

Can it, then, truly be said that the variety of natural foodstuffs consumed by Europeans protects them from any deficiency of vitamins? My own clinical experience justifies no such belief; rather does it point in the contrary direction. Nor does it appear to be the experience of the compilers of the Thirty-Eighth Report of the British Medical Research Council, who write: "From a consideration of dietaries consumed by the poorer classes in the towns of Great Britain, one is led to suggest that no inconsiderable proportion of the population is existing on a food-supply more or less deficient in fat-soluble factor"—deficient, that is to say, in a vitamin one of whose cardinal functions is to maintain the natural resistance of the subject against infections. That similar considerations apply in this country also appears from the experience of Osborne, who asserts that a large part of the food eaten by civilized people has been deprived of Vitamin B by "improvements" in manufacture, and of Hess, who emphasized that latent and subacute forms of scurvy due to insufficient intake of vitamin C are common disorders of infancy.

But the frequency with which deficient and ill-balanced foods are used is most apparent when the dietetic habits of persons in subnormal health are considered. It will surprise those who study them to find how many there are, of capricious appetite, who habitually make use of foods sometimes deficient in calories—for it is not the food presented to the subject that counts, but the food eaten and assimilated—and often dangerously deficient in one or more vitamins, in protein of good biologic value, and disproportionately rich in starch or sugar or fats, or in all three. Infants fed on many of the proprietary foods in common use come within the category of the deficiently fed, unless deficiencies are made good. The food of young children is commonly low in vitamin content, and in suitable salts and protein, while it is frequently disportionately rich in starch and sugar—a circumstance which enhances the danger of vitamin deficiency. It may, indeed, be accepted as an axiom that the vitamin value of a child's food is reduced in proportion to its excessive richness in carbohydrates.

But the ranks of the deficiently fed include not only infants and young children; they include also those whose food is composed mainly of white bread, margarin, tea, sugar and jam, with a minimum of meat, milk, eggs and fresh vegetables. Even among those whose diet is more perfectly balanced, the commoner articles of food, as they are prepared for the table, are so low in vitamin value that, unless they are enriched with a sufficiency of natural foods in the raw state, they are prone to cause ill health, and especially gastro-intestinal ill health. Such is my experience in India, where this European patient "cannot digest vegetables or fruit," and never touches them, as they carry infection," or that one "suffers so from indigestion" that he or she lives chiefly on custards and milk puddings; where milk is, of necessity, boiled and reboiled until, as a carrier of vitamins, it is almost useless; where meat is made tender by simple device of boiling it first and roasting it afterward; where every third or fourth European child has mucous disease, the direct outcome of bad feeding. So it is that the forms of food which such as these so commonly adopt are those most calculated to promote the very disorder from which they seek relief.

Access to abundance of food does not necessarily protect from the effects of food deficiency, since a number of factors—prejudice, penury, ignorance, habit—often prevent the proper use and choice of health-giving foods. Who in the ranks of practicing physicians is not familiar, among the well-to-do classes, with the spoiled child of pale, pasty complexion and unhealthy appetite, of sluggish bowel, and often with mucous stools or enuresis, who, derived of the wholesome ingredients of a well-balanced natural food, craves for sweetmeats, chocolates, pastries and other dainties as devoid of natural health-giving properties as their excessive use is common? Constantly one encounters the anxious mother of the "highly strung," "nervous" child "of delicate digestion," whose ignorance of essential principles of feeding is only excelled by her desire to do what is best for her offspring; who, guided by the child's preferences, supplies the means to convert it into a static, constipated, unhealthy-skinned adolescent, equipped with digestive and endocrine systems wholly unfitted to sustain the continued exercise of healthy function. Or, again, who is not familiar with the overworked anemic girl, static and with visceroptosis, acne or seborrhea, and oftentimes with vague psychoses, who ekes out a paltry wage for teaching, sewing or selling, satisfying the cravings of her tissues principally with white bread, margarin and tea? Or with the languid lady, devoid of healthful occupation, who, living in the midst of plenty, deprives herself, for some imaginary reason, of substances essential to her well-being? Or with the harassed mother of children, oppressed with the constant struggle to make ends meet, stinting herself that others may not want, exhausted by childbearing and suckling, worry, and too little of the right food? What wonder that such a woman is dyspeptic, and that "every bite" she eats "turns on her stomach." Some there are, living in luxury, whom ignorance or fancy debars from choosing their food aright; others for whom poverty combines with ignorance to place an impassable barrier in the way of discriminating choice. It is for us so to instruct ourselves that we may instruct such as these, and use our newer knowledge to the end that customs and prejudices may be broken and a more adequate dietary secured for those under our care. We may, in our desire to promote the health, vigor and fertility of our people, learn much from the practical farmer or stock-breeder whose experience has taught him that all these evidences of normal functional activity of the animal organism are dependent in the main on one great factor—perfect food supply.

CONCLUSION

I trust that I have said enough to serve as an introduction to the study of this important subject, than which there is none more worthy of the consideration of those whose life is spent, or to be spent, in guarding the national health. It seems to me that in regard to it we have three obvious duties; the first, to instruct the masses as to what to eat and why to eat it; the second, to apply the results of our science to the production of natural foods in abundance and to their widespread and cheap distribution, rather than to the erection of institutions for the treatment of maladies due to their want; the third, and most important, ardently to pursue our investigations and the acquirement of knowledge. In no department of human endeavor are the words from the agrapha of Christ more pertinent than in their application to the study of the relations of food to health and disease:

> Let not him who seeketh, cease from seeking until he hath found:
> And when he hath found he shall wonder.

MEDICAL PERIODICAL LITERATURE

PRESIDENT'S ADDRESS, DEC. 6, 1921.

GEORGE H. SIMMONS, M.D.
Editor, Journal of the American Medical Association

The presidential address for an organization such as the Institute of Medicine should be devoted to a discussion of a scientific subject in which at least a majority of its members are interested. When I cast about for such a subject I realized that, if I attempted to select one of such character, I might flounder and get beyond my depth. But, as former presidents selected subjects related to their particular lines of practice or work, I have done the same. An intimate acquaintance of nearly thirty years with medical journalism has perhaps given me an exaggerated idea of its importance; my subject, however, is closely related to the advancement of medical science, and this would be my apology, if an apology were necessary, for selecting such a dry and prosaic subject as Medical Periodical Literature.

MEDICAL JOURNALS

In its earlier years, the American Medical Association conducted its scientific work through committees. In 1848, Dr. Oliver Wendell Holmes, who that year was chairman of a committee on medical literature, read a report which concerned medical journals and medical books, rather than medical literature itself, in which he said:

> In the course of half a century from the establishment of the first of the medical journals, their number has been gradually rising, until at the present time, at least twenty are known to be in existence.

What *would* Dr. Holmes say today! It is difficult to trace the growth of medical journals from 1848 until the early seventies; from that time it can be done roughly from newspaper and medical directories. During the period from 1870 to 1900, at least 450, probably nearer 500, medical journals were started, many leading an ephemeral existence of but a few months or years. The peak was reached in 1903, when there were a little over 230.

Seeking an explanation of the twenty periodicals of 1848, Dr. Holmes said:

> Some principle in addition to the wants of the reading community must exist to account for such inordinate fecundity in this particular department. This is to be found in the homely fact that a medical journal is a convenient ally and advertising medium for public institutions and publishing establishments.

He says nothing, it will be noted, regarding the medical journal's position as a convenient ally and advertising medium for proprietary medicines. The reason is simple: The proprietary medicine business, as we know it, did not exist; it developed and flourished during the thirty-five year period ending in 1905; and it was during this period that the truth of the saying, "Whose bread I eat, his song I sing" had a practical demonstration in both the reading and the advertising pages of the vast majority of the journals.

The number of medical journals began to decrease in 1905, and today there are approximately 120, as against 230, sixteen years ago. Not only has there been a decrease in number, but an entirely different class of journals has appeared—purely scientific journals unhampered by, and free from, selfish commercialism. I refer to such publications as the *Journal of Medical Research*, the *American Journal of Anatomy*, the *Journal of Infectious Diseases*, the *Journal of Biological Chemistry*, the *Journal of Bacteriology*, the *American Journal of Physiology*—to mention a few. Prior to 1900, only one of this class of journals existed: the *Journal of Experimental Medicine*.

About this time, also, state medical associations began to substitute monthly journals for their annual transactions. Today there are thirty state journals, representing thirty-six state societies.

My subject, however, is not medical journals nor medical journalism. I make this brief retrospect simply as a background for the main theme.

MEDICAL ARTICLES

There is a distinct change in the type of papers appearing in medical journals today as compared with twenty years ago. The therapeutic article of the past, replete with favorite prescriptions, often proprietary in character, has given way to scientific contributions on therapeutic methods, on pharmacology, on pathology, on etiology, on methods of diagnosis, on prophylaxis. The difference between then and now in this regard can be appreciated only by those who were in practice eighteen or twenty years ago, or by those who take the trouble to compare the journals of that period with the publications of today.

While there has been a decrease in the number of medical journals, there has been no decrease in the number of medical articles. During the first eleven months of the present year—up to December 1—there were voluntarily submitted for publication in *The Journal of the American Medical Association* 1,335 manuscripts. To the 1,335 must be added 285 section papers, making a total of 1,620 for the eleven months, or approximately 1,750 manuscripts during the year. This is about the average for the last four or five years. A fair percentage of these papers were excellent, both in matter and in manner of presentation; many were valueless as scientific contributions, and not creditable as literary compositions. Between these two extremes was a greater number deficient either in matter or in manner—and more often the deficiency was in the manner of presentation.

We estimate that three fifths of the manuscripts voluntarily offered to *The Journal* for publication are returned. Why? What are the principal reasons for their rejection? With such a large number of papers, one would naturally suggest "lack of space" as the principal reason. And this would be partially, but not entirely, correct. No matter how many may be on hand, a well-prepared paper on a timely and practical subject—one that will appeal to a fair proportion of readers, especially to general practitioners—is accepted. A paper that is informative, that presents new facts or practical information, if fairly well written, is not returned.

Naturally, there are various causes for rejecting manuscripts, aside from lack of space: One is a plethora of material on one question, with the peril of devoting too much space to a given subject. This is likely to happen when a new treatment is introduced, a new theory advanced, or during and immediately after epidemics. The introduction of arsphenamin was followed by an ever-increasing lot of papers on the subject, all optimistic; Wright's opsonins and opsonic index produced a flood of articles of varying character; focal infection, long since threshed out, is still a live subject, judging from papers received, few of which contain new facts or new scientific evidence; the tonsils and tonsillectomy, and especially intruments for doing tonsillectomies, have been sadly overdone. After the armistice came a deluge of papers based on war experience, and the stream is not entirely dried up.

But, no matter how much a subject may have been discussed, or how much space may have been devoted to it, it is not overdone so long as new, worth-while facts, or new, scientific evidence, are forthcoming.

FANCIES VS. FACTS

Naturally, too, there are offered productions of theorists who, without scientific knowledge, have solved problems that are puzzling research workers and scientists. The number of physicians who have the courage to discuss scientific problems, concerning the fundamental and elementary principles of which they are entirely ignorant, is larger than many imagine. Such papers usually are returned with the suggestion, circumspectly phrased, that an ounce of fact is worth a ton of theory.

That every physician has a right to express his opinions, to advance theories, and to make known his discoveries, is an accepted principle, and he should not be denied these rights by an editor without a good reason. But the reader has his rights also, and they should be paramount. He has the right to demand that the editor shall not publish fiction for fact or fallacies which he—the reader—is not qualified to detect. The editor is supposed to have knowledge of the author and of his dependability that the reader cannot have. The reader certainly may expect that the editor will comb out such material as is obviously false.

A few years ago a well-known physician sent for publication a paper in which he claimed that he had discovered a bacterial causative agent for a not uncommon, apparently noninfectious disease The discovery, if true, was epoch making. The average reader, especially if he had not been trained in bacteriology, might easily have been deceived and have accepted the author's statements as dependable evidence. To the bacteriologist, the organism was reminiscent of a common contaminator in careless work. But the author was a man of well-earned national repute and a frequent contributor to medical literature. Recognizing that the judgment of great men may be warped by overenthusiasm, the editor was, nevertheless, influenced by the author's reputation; he felt that the responsibility in this instance should rest on the author and the paper was accepted. In this case, therefore, the paramount rights of the reader were overlooked.

Recently a manuscript was submitted in which the author advanced the theory that both the cause and the cure of cancer were matters of diet. The evidence submitted, however, was not convincing and, in spite of the fact that this author also was nationally well known, the paper was returned. Shortly afterward it appeared in an eastern journal. Its publication has done incalculable harm.

Not long since, an article entitled "The Etiology and Elimination of Tuberculosis" appeared in a medical weekly. It was full of fallacy and misstatements. For instance: "The vaccine as employed against smallpox contains syphilis and is the primary cause of the white plague"; "syphilis is the primary lesion that allows the development of tuberculosis." Further on the reader was told, as by one of authority, that syphilis is the cause of cancer. Undoubtedly the readers of the journal in question sent some emphatic protests. Instead of apologizing, the editor justified his action in publishing the article by saying: "As it was written by a physician practicing medicine we decided that it should come to light, in spite of its weird conclusions. We believed that it should be presented before the medical profession and cause a healthy discussion." This editor was not true to his readers. The two papers just referred to are being used by faddists and enemies of scientific medicine. Far more harm is done in the publication of such fallacious matter than in procrastinating with or rejecting a dozen papers offering new theories and new evidence which may be of value but which are not thoroughly convincing.

SOCIETY PAPERS

Papers read before medical societies often are not of a character to elevate the tone of periodical literature, or to add to the sum total of our knowledge of scientific medicine; as a rule, they are not well thought out or as carefully written as are those prepared especially for printing. And this is excusable. Such papers are written from a sense of duty. The author may have something that he is anxious to present to his fellows; more likely he has not, but selects his subject somewhat haphazardly. After all, the principal object of such papers, especially those read before local societies, is to bring out a discussion.

Then there is the specialist or consultant from the city who is invited by a society to visit it and to present a paper. Papers by such men are more likely to be well worked up than in the former case. The visitor is anxious to make a good impression; he will try to enlighten his hearers on the subject he presents. He thus brings profit not only to others but also to himself. Quite often, however, such papers may rightly be dubbed "pot boilers." They too are usually written for reading, not for printing.

A society paper may be ideal for the purpose for which it is written, and yet not at all suitable for publication. It may be ungrammatical, discursive or verbose, or poorly organized without sequence in argument or arrangement of the subject. And yet the author's presentation, his inflections and, above all, his personality, will carry over, not only without the audience discovering any fault, but with applause as he reads and congratulations at the end.

If the author is to be the only speaker, his anxiety will not be how briefly he can present his subject, but, rather, that he must fill the time he is expected to occupy. Brevity, conciseness, the elimination of unnecessary details, and the avoidance of branching off into unrelated and irrelevant subjects will give him no concern. He will consider as appropriate and proper the relating of unimportant incidents in his experience, as, for instance, a case report, an occasional aside, making personal allusions and using colloquial language. And he will be right. But he will not be right if he submits his article for publication without modifying it. Common courtesy compels his audience to remain and listen until he is through; but if his paper is prolix or rambling, it will have few readers; the personal equation does not enter in, and the courtesy of the listener has vanished; it is now cold type. There used to be a monthly medical journal that had this standing notice:

> Articles read before societies will not be accepted. Only those written for this journal will be printed.

I sometimes wish the rule were general. I am underestimating when I say that 10 per cent. of manuscripts have been returned because they had been prepared for reading before a society and were then submitted without revision. To a great extent it is these papers that overburden our periodical literature. A manuscript that is fit to read is sometimes fit to print, but a manuscript which is fit to print is always fit to read.

LENGTH

An occasional reason for the return of a manuscript is its length. But, like Einstein's theory as to space and time, length in this case is a matter of relativity. A paper of five hundred words may be long; one of five thousand may be short. The primary point is not length, but whether the material justifies the length. Usually manuscripts are unnecessarily long because of easily avoidable faults in construction, such as rambling, verbosity, prolixity or diffuseness.

RAMBLING, a most common fault, is the result of writing without planning. It can be overcome by organizing and by systematically laying out or plotting the subject at the beginning, as in the ordinary textbook on medicine, in which the formula is: definition, etiology, pathology, diagnosis, prognosis and treatment. Each phase of the subject is completed under its own caption. Systematic organization not only prevents rambling—going a long way round to get to a given point—but also promotes a complete discussion, without repetition. Naturally, not all subjects lend themselves to this procedure; those of any length always do. Scientific literature is a record of facts and, therefore, style is of minor importance; but to record facts as they should be recorded, it is necessary to sort and then to arrange them in logical order. This is an important factor in style so far as medical papers are concerned.

Center heads break up solid type pages which repel the reader. They have an added advantage in aiding the author to present his subject logically and concisely. It is to be regretted that center heads are not more commonly used in medical journals.

VERBOSITY is a blemish in the writings of most of us, and one that makes reading tedious, mars diction and wastes space. This fault can be overcome easily, but in most instances, efficiently only after the paper has been written. Unless one has tried it, one will be astonished at the number of words, phrases, clauses, sentences, and, occasionally, paragraphs that can be deleted without affecting the meaning in the slightest degree. The process always improves the grammatical construction and style of expression.

Quiller-Couch, in "The Art of Writing," devotes a chapter to the use of unnecessary verbiage. Here is one of his illustrations:

> A clerk of a Board of Guardians had to record a minute relative to the burial of a pauper. The minute reads:
>
> "In the case of John Jenkins, deceased, the coffin provided was of the usual character."

Sir Arthur pulls it to pieces. First, it is superflous to tell us that Jenkins is deceased; the fact that he needs a coffin is sufficient evidence. Then, "in the case of" is superfluous, for Jenkins did not have a case; he had, and needed, only a coffin. Further, the coffin was not "of the usual character," for coffins have no character. The clerk of the Board of Guardians should have said: "John Jenkins was provided with the usual coffin."

Let us take some specimens from real life—from manuscripts submitted to *The Journal of the American Medical Association.* Here is one:

> I do not hesitate to say that in my opinion the gland in this case should not have been removed.

The first seven words are space takers; the author makes his statement and the reader cares not whether he hesitated or did not hesitate in making it. In any event, "I do not hesitate to say that" was bracketed and deleted, and the better and shorter sentence, "In my opinion the gland in this case should not have been removed" was printed. "In my opinion" might have been deleted.

This from another author:

> It has been a mooted question in the minds of microbiologists whether the gonococcus possesses a capsule.

What difference there is in this case between a mooted question and one that is not mooted I do not know; "mooted" was deleted. "In the minds of microbiologists" carries the idea that only microbiologists are concerned. The sentence was improved by divesting it of unnecessary verbiage, and, when printed, it read:

> It has been a question whether the gonococcus possesses a capsule.

The purist would have modified this still more and given the microbiologist a show, making it read: "Microbiologists question whether the gonococcus possesses a capsule."

This from another article describing an apparatus:

> Physicians who have been using radium needles will readily appreciate the difficulties encountered in threading them.

"Who have been," "will readily" and "encountered" were deleted, and the sentence read:

> Physicians using radium needles appreciate the difficulties in threading them.

PROLIXITY OR DIFFUSENESS—that is, tedious discussion of nonessential details and particularizing on trivialities—is not necessarily a fault in style or diction; it is a failure in discrimination as to what should be included. The temptation to all of us is to spread ourselves. Prolixity is especially noticeable in exhaustive analyses of previous work on the subject the author is presenting. Ambitious to make a complete and exhaustive review of the literature, he includes long abstracts of material of minor importance and irrelevant or only distantly related to his subject. Reports of postmortem examinations usually are too detailed, and contain material of no direct bearing on the subject in hand. Sometimes such a report is practically the transcript of the stenographer's record, dictated as the examination progresses. Reports on research work and laboratory investigations often are lumbered with unnecessary details. Our German confrères, noted for their attempts at encyclopedic detail, have been inclined to elaboration and prolixity, and American physicians, especially the younger men, in the past have been prone to follow their example. Set addresses, foundation and commemorative lectures, must necessarily be long—the occasion and the time to be occupied, if not the subject, require it. Unusually long and elaborate papers cannot be avoided in treating some subjects satisfactorily. I would repeat: It is not the actual length, but whether the subject-matter justifies the length.

CASE REPORTS

The foundation of clinical medical literature is the case report, a species now becoming, for some unknown reason, almost extinct. One cause given by the editor of a Swedish medical periodical is the fact that the scientific level of our profession has risen so much in recent years that a physician hesitates to report an interesting case simply as a case report; he thinks he must make an exhaustive survey of the literature. Instead of a brief, practical report he submits an exhaustive review which few, if any, care to read, and which is unnecessary. Often a mass of detail, including unimportant, irrelevant and negative findings, is presented without regard to clearness of expression. Never a week passes that *The Journal* does not receive papers of this character. Usually if the historical review appears to be unnecessary and the case is an interesting one, the author is asked to permit the publication of the case report without the review. Clinical reports made with judgment and with the correct appreciation of relative values are always welcomed by both editor and reader.

BEGINNING

Let us now touch on one or two minor points: The beginning of an article often is the most difficult part to write; yet the difficulty is easily overcome. A good rule is, go right to the subject without preliminaries; begin in the middle, if necessary. When the paper is written, it is easy to go back and write the beginning, although nine times out of ten it will be found that this is unnecessary—the beginning has already been written. The majority of manuscripts reflect the struggle the author had in getting started. He flounders round and writes about matters that have little to do with his theme, and, finally, after spoiling a page of manuscript, gets down to his subject. In such cases, deleting the introductory paragraphs remedies the trouble. It is well not to have chaff at the beginning; the reader may conclude there is no wheat, and skip to the next article.

TITLES

If an author desires his contribution to become a part of the literature on the subject, he must give it a name that will identify it—a title that is descriptive. Thousands of papers lie buried because their titles did not designate the subjects. Titles should be short, but inclusiveness should not be sacrificed for brevity. Often a long title may seem necessary, although usually it can be made short and clear by using a main title and a subtitle.

This was the original title of a section paper—it is a mouthful: "To Obtain Graphs Showing the Rapidity and Degree of Decrease in Temperature in the Eye and Orbit Produced by the External Application of a Given Degree of Cold over a Given Area for a Given Time, and a Numerical Expression, at Least Approximate, of the Relation of These Variables to Each Other." What can the poor indexer or cataloguer do with such a title? It became, with the author's permission, "On the Coefficient of Thermal Conductivity of Eye and Orbit Measured with Cold Applications."

Misleading titles should be avoided. "A New Chloroform Danger" was the caption of a recent manuscript. This would have been misleading, for any one looking up the literature on the dangers of anesthesia would have been attracted by the title and would have discovered that he had been misled. The title became: "Danger in Similarity of Ether and Chloroform Containers," which exactly stated the subject of the communication. First impressions are lasting: A catchy title catches readers. The title ought to be carefully thought out; it should give a clear indication of what is to come.

DIGEST AND CONCLUSIONS

A brief digest of a long article in the introductory paragraph often will stimulate some to read the article who otherwise would not. Conclusions at the end are of special value, particularly as they lend to wider publicity. Conclusions are "fat" for abstractors and for editors who are looking for "fillers." If an author is anxious to have his conclusions reproduced by other journals, they should be rigidly condensed, yet clearly reflect his premises and deductions.

BIBLIOGRAPHIC REFERENCES

"Bibliographies," says Gould, "often are the veriest shams, appended to give a show of erudition, and their indifferences and imperfections are self-confessions of the fact." This was written twenty years ago; it applies today. Bibliographic references are of value only when the references cited (1) amplify or illuminate the subject, and (2) are accurate and complete. To include references to articles that are worthless in themselves, to those that have no bearing on the subject, and to such that duplicate or rehash papers already referred to in the bibliography is a common fault. Inaccurate and incomplete references are altogether too common. When one procures a book or journal indicated by a reference, often at much trouble and possibly expense, it is irritating to discover that one has been sent on a fool's errand—that the article wanted is not there. References to articles that have no special bearing on the subject in mind, and inaccurate and incomplete references indicate that (1) the author has been careless, that he himself has not seen the articles and hence does not know whether they are worth referring to or whether the references are correct; or (2) that he has "lifted" his references from an index or from another author. It is often possible to detect filching: if references vary in style, one giving volume and page; another, year, month and page, and still another, page, volume, month and year, it is pretty good evidence that some, if not all, of the references have been "lifted."

References should follow a definite style. Naturally, we regard the style used in the *Quarterly Cumulative Index* and in the other publications of the Association as best. It is the style used by the *Reader's Guide* (the standard cumulative index for lay publications and general literature), the *Industrial Arts Index,* which includes architectural and similar literature, the *Agricultural Index* and others. This style requires that the data shall be arranged in the following order: (1) author's surname and initials; (2) title of article; (3) name of periodical, abbreviated; (4) volume, in bold-face Arabic numerals, indicated in the manuscript by a wavy line under the numeral; (5) page; (6) month—day of month if a weekly—and (7) the year. This style is inclusive, yet brief and simple.

CHARTS; ILLUSTRATIONS

Illustrations such as charts, photographs, photomicrographs, roentgenograms, tables and diagrams are vital factors in some articles. Yet few authors seem to have any conception of the problems connected with their reproduction and printing. They send charts made on paper with the horizontal or vertical lines ruled in blue, which are lost in reproduction, since blue takes white when the engraver photographs it. Or there are many fine lines in red or some other color that photographs black, so that when the chart is reduced in size these lines run together. Often the temperature, pulse, respiration and other curves are indicated by different colors instead of different forms. Contrast should be obtained by the use of solid, broken or dotted lines, or such forms as stars or circles. The point to be emphasized is that the use of colors in charts should be avoided. Charts should be made on white paper ruled in black, and the tracings also should be black. Photographs are too often of the amateurish type, reflecting credit on neither the author nor the journal in which his article appears; and usually they do not illustrate. Tables are cumbersome and unwieldy because the author includes more columns than are required and does not know the importance of condensation in tabulating material. Scores of manuscripts have been unavailable because the illustrations were unsatisfactory.

MANUSCRIPTS

It is unwise to ignore the fact that the general appearance of a manuscript has a psychologic effect on an editor. A manuscript carelessly arranged, without pagination, with sheets of various sizes, with additions written on slips pinned or clipped to the side, with corrections made without regard to neatness or clarity, may prejudice the reader who is to pass on its merits. Even the serene and gentle editor of the *British Medical Journal* was compelled recently to give voice to his trouble: "It is common," he said, "for a surgeon to send in a bundle of sheets of paper of various sizes, fixed together with a safety pin, and containing, mixed up with the text, rough diagrams and bedside charts, perhaps sprinkled with notes and defaced by blots and corrections." Such slovenliness is inexcusable. Some men are habitually slovenly with their manuscripts, just as others are slovenly in their dress. Slovenliness has caused the return of hundreds of manuscripts which otherwise might have been accepted.

The size of the paper, while a small matter, is worth mentioning. The standard size adapted to the ordinary typewriter, the linotype machine and filing case is 8 to 8½ by 11 inches. At least 90 per cent. of the manuscripts received by *The Journal* are of this size. The other 10 per cent. vary from small note sizes to foolscap or worse.

Submitting a carbon, rather than the original, copy of a paper may have a bad effect; the editor may think the original has been sent to some other journal—at least he will think that the journal he represents has not been treated courteously. Some editors are sensitive on this point. There are practical reasons why editors prefer good, clean—the original—copy: each manuscript is read by at least one editor; then, in turn, by the copy editor, the linotype operator, and the proof reader or copy holder. Except the editor, each of these must note the spelling of every word, every punctuation mark and capital letter. The wise author, however, will retain a carbon copy and thus be able to compare it with the proof and see what, if any, liberties have been taken with his manuscript. In this manner he may discover some faults in his writing and indirectly secure criticism which will aid him in the future.

A manuscript typed in single—that is, close—space is objectionable: no matter how well written, how carefully prepared, the keen eye of the copy editor may find typographic errors, misspelled words, grammatical slips, or what not, that require interlineation. These and other corrections are made with difficulty on closely typed manuscripts. It is as easy to have a manuscript typed in double, as in single, space; it merely requires a little more paper.

The unforgivable crime is the carbon copy, single spaced. So far as our journal is concerned, such manuscripts are returned.

INCORRECT USAGE OF WORDS

As bricks are the individual elements that form the structure of the house, so words are the individual elements in the structure of an article. Words poorly chosen or wrongly used, like cracked or discolored brick, may destroy the pleasing effect of an otherwise perfect edifice. The right and wrong use of words is too large a subject to discuss here, but I want to mention a few solecisms which I regard as abominations.

CASE.—"Case" is the incidence of a disease, the totality of the symptoms and of the pathologic and other conditions; "patient" is the human being, the man himself. "The case had quite a temperature," "I put the case to bed," "This case was taken ill three weeks ago," "I sent the case out for a walk"—these and similar expressions are found continually in manuscripts; the error nearly always is in using "case" for "patient," seldom the reverse.

TO OPERATE.—A flagrant disregard of the rules of grammar is the deplorable misuse of the verb "to operate," which has gradually developed among a small group of American surgeons. "Operate" means, and is synonymous with, "to work"; the terms nearly always may be used interchangeably. The surgeon who would hesitate to say, "I worked this patient," says without a blush, "I operated this patient." A search of every available dictionary has failed to reveal any indication of an excuse for this abuse of the word "operate." This solecism is limited to a group that represents one in seven hundred of our population—the medical profession—and, to only a small proportion of that group—thoughtless surgeons. It is also limited to this country. American surgeons who justify themselves by saying that general usage makes correct usage should realize that "operate" is a word in general use wherever the English language is spoken; it is not limited to medicine. Men operate on the board of trade, but no one, not even our surgeons, refers to them as "operating" the board of trade. Our linotype "operators" cannot operate "on" the linotype machines; the unions will not permit it. We are compelled to employ a machinist "to operate" on the machines. Even if the term were limited to medicine good usage is not that of the majority, but that of the educated majority. The pity of it is that certain teachers in our medical schools—professors of surgery—instead of setting an example to their students in the proper use of this verb, are responsible for the spread of its improper use.

But the language of the surgeon is progressing; here is a quotation from a recent manuscript:

> It was decided that the patient should be explored with the expectation of finding an acute appendix.

The decision made, our surgeon did not hesitate; he explored the patient. Another surgeon was not so courageous: "We have contemplated having some of our inoperable cases collapsed by thoracoplasty," he says, "but have delayed." And finally, *horribile dictu*, in a manuscript for the *American Journal of Diseases of Children*, the author says: "In a case in which I obstetricated at birth." And so we "operate," "collapse," "explore," and "obstetricate" our patients.

This use of intransitive verbs in the transitive sense has no justification in the laws of grammar. Even less justification exists for transposing an ordinary common noun into a verb that does not exist. Astronomers never telescope the sky; bacteriologists never microscope their slides; but the urologist cystoscopes his patient. And in the same way, the bacteriologist who would not microscope his slides will Schick one patient, or Wassermann another. Certain rules of language and grammar are fundamental, and the canons of good writing and correct speaking govern medical, as well as other, literature. There is no place in scientific writing or speaking for such jargon or ungrammatical monstrosities.

My comments have been based chiefly on manuscripts submitted for publication in *The Journal* and in the other publications of the American Medical Association. Before printing, manuscripts pass through the copy-editing room, in which they are corrected so far as may be and prepared for the printer; hence some of the faults to which I have referred will not be found in the printed matter. "Cases" are not "sent for a walk," nor are patients "operated," "collapsed," "explored," "Schicked," or "obstetricated," in the articles as printed. Case reports are worked into fairly understandable English, crude charts are remade, and compound comminuted sentences are corrected.

But modifications by the printer should be unnecessary, not alone because the author should be responsible for his own productions, but also because modifications by another may change the meaning. Further, and particularly, every writer has a style of his own, and that style should be respected if it conforms to the ordinary rules of rhetoric and grammatical construction. Surely the percentage of physicians without educational qualifications for grammatical writing is small nowadays. The trouble is, few medical writers do their best or take the matter of authorship seriously. Any one who can write an ordinary, logical letter can write a paper acceptable to any journal, if he will take the time and trouble to do so. But writing—whether a letter or an essay—is an art. And to become proficient in any art requires work—practice. This applies to writing as much as it does to music, to painting, to sculpture and to the other arts. Perfection in any of these is reached only by practice. The fundamental principles on which good writing is based are taught in schools and colleges; yet little time is given to applying these principles by actual practice. There are schools for sculpture, painting and music, in which these arts are practiced, but

I know of no school for writing. Here and there little coteries of writers are formed for mutual assistance. I have often wondered why such groups are never formed in medical schools by students who have some ambitions for authorship and who could in this way mutually aid one another. Such an arrangement was initiated twelve or thirteen years ago in the Harvard Medical School by Dr. Burrell, professor of surgery. He described the general plan to me and later sent a proof of a circular for his students, outlining the course. How far he carried it out I do not know—not far, I fear, because of his illness, which incapacitated him for some time before his death. The plan would be ideal in hospitals in which there are a number of interns.

REVISION

I have said that writing is an art and requires practice. But the busy physician has neither the time nor the inclination to practice writing simply to improve his style. Writing is neither his vocation nor his avocation; it is a means to an end. What, then, should he do that his contributions to the literature of his profession may be creditable? The answer is: Revise, revise, and again revise his manuscript before submitting it for printing.

Few of us can write a paper of any length suitable for publication without revising and rewriting at least once. And yet I am sure that more than half the manuscripts I read have not been revised, according to the meaning of the term. Webster's definition is: "To review, to reexamine, to look over with care for corrections, as to revise a writing." This means something more than an uncritical, superficial reading of a manuscript to determine how it sounds. Such reading may satisfy the ear, but it does not satisfy the mind.

Consider how the average manuscript is written! The doctor surrounds himself with some textbooks, reprints, a few periodicals and some penciled notes, and starts to write his paper, probably in longhand. After more or less worry, and possibly some sleepless nights, he breathes a sigh of relief, thanks Heaven that is finished, and has it typewritten. He may read the typewritten copy and make one or two corrections before sending it to a medical journal; more likely, he reads it before a society and then, without any revision worthy of the name, sends it in. Not a few manuscripts submitted for publication bear evidence that the only reading given was that of the typist, and she frequently has not corrected her own misspelling. "To have a manuscript typewritten," said an editorial writer in the *British Medical*

Journal recently, "and then to send it in for publication without revision is a crime comparable to operating with unwashed hands."

Let me presume to give a little advice to those young men who are anxious that their printed productions shall be creditable: After the manuscript is typewritten and you have given it an ordinary, careful reading, to see that it sounds all right, give it not less than two critical readings. Read it first to see whether you have included all the facts or arguments you intended to include, whether their sequence is logical or whether rearrangement of certain paragraphs would be an improvement. Now have it retyped, for this will be necessary if you have made the first critical reading as it should have been made. The second critical reading is more important; while both require close application, the second requires also concentration. The object now is to improve the style, to eliminate unnecessary verbiage, and to correct slips in grammer and in construction. The matter may be forgotten; the manner of presentation is to the fore. Our copy editors go through a manuscript scarcely knowing the subject; they read it as a composition to be corrected. This is what you should do when revising your manuscript. By the time you have gone through the copy a second time, it will be so marked up that you will be compelled to have it retyped. After the two critical readings, it is quite likely that you will have become more interested and probably you will read it the third time and indicate more corrections, making it necessary again to have it retyped. What of it? The expense is small; the big thing is that you are now practicing in a most practical manner "the art of writing." And it is the only way in which the average physician can, or will, practice the art.

Sir Clifford Allbutt, in that excellent book, "Notes on the Composition of Scientific Papers," tells us that in writing an article he jots down on slips of paper ideas and facts as they come to him, which, after being arranged in logical order, form the basis for what he describes as "a hasty, first draft." "This first draft finished," Sir Clifford continues, "the work may now be regarded as half done. I usually make four drafts at least before the manuscript is finished." "After the second draft," he says, "I delete redundant words, phrases, sentences and paragraphs." On the third draft, "the composition is submitted to still closer revision; but the main work of this stage is to recast paragraphs and sentences until they run logically." Lastly, before the final revision, he lets a week at least elapse, "in order," he says, "that the final reading may be done with refreshed attention." Sir Clifford Allbutt is regarded as one of the greatest among modern English medical writers. In view of his method of writing, is the fact surprising?

While in Oxford, last August, I saw the Osler Library—a remarkable collection of books, pamphlets and manuscripts. Osler's own annotations and an elaborate index are being completed preparatory to the transfer of the library to his alma mater, McGill, to which he bequeathed the collection. Accidentally, my attention was called to some of Sir William's manuscripts. They reveal the man. We have all regarded Osler as one of our best medical authors. His first textbook on medicine was ideal in its concise and graphic descriptions, in its compact grouping of facts in clear, simple English. As Dr. Finney, in his Osler oration, says:

> Of Dr. Osler's literary style it has been well said that his own estimate of some of the old writers may, with equal truth, be applied to him: "A rare quaintness, a love of odd conceits, and the faculty of apt illustration." There is a clarity of diction, a charm of expression, an epigrammatic style in all his writings that stamp them with a certain individuality that must leave a lasting impression on medical literature.

Some, no doubt, have envied Osler his easy command of English; but the manuscripts soon to be available in Montreal tell the true story. There were notes on paper of various kinds—backs of envelopes, for instance—evidently written on trains and at opportune moments; these form the foundation. The manuscript of the article I particularly noticed consisted of: (1) a rough outline in longhand; (2) the first typewritten copy, with interlineations, transpositions and deletions; (3) the second typewritten copy, which also had been considerably modified, and (4) the third typewritten copy that evidently had been used for printing. This final typewritten copy had three or four minor corrections.

We have all read Osler's tribute to that little word which he regarded so reverently—"work." If Sir Clifford Allbutt and Sir William Osler—the latter even in his riper years—found it necessary to revise their manuscripts three or four times, what about the rest of us?

We are leading the world in medical research, in medical progress; our profession at least equals that of any other nation in educational qualifications, both academic and professional, and in scientific attainments. Let us be an exception to the charge made by Sir James Barry, when he says: "The man of science appears to be the only man who has something to say just now, and the only man who does not know how to say it."

THE LITERARY TRADITION IN ENGLISH MEDICINE

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The main characteristics of English medicine, as distinguished from such strains as the French, the German or the Italian, are a spirit of strong, practical common sense in bedside medicine and an achievement in experimental physiology and other branches of laboratory medicine, which, often attaining the highest eminence, has been largely a matter of individual genius and effort rather than of organization, and which has always been devoted to the demonstration of a provable hypothesis rather than to the vagaries of aimless, footless and fitful speculation. As shown by the modern English writers and satirists, the shortcomings of British medicine, where apparent, have usually been associated with the somewhat artificial character of English society in the past. As enacted law is only codified custom, so social custom, in England, until recent years, has been apt to harden and stratify into phases of conservatism which were almost the equivalent of rigid law, as witness the social disabilities put on physicians and sanitarians even during the early Victorian period. At the outbreak of the European war, however, the medical profession of Great Britain was found to be in excellent form and did splendid team-work for the cause, both in the army and out of it. But vast expenditure and waste of time and money was incurred in England, as well as in the United States, through lack of forehanded organization (preparedness) at the start, as predicted in Karl Pearson's introduction to the Ninth Edition of the "Encyclopedia Britannica," This is all ancient history now, but a powerful sermon on the text:

> In ruling classes, and in social circles which put on aristocratical fashions, ideas, and especially scientific ideas, are held in sincere aversion and in simulated contempt. (Allbutt)

English medicine attained its stride progressively in Linacre, Harvey and Sydenham. It is highly significant that the first should have been a medical scholar and grammarian, the second one of the greatest of experimenters in physiology and embryology, the third the greatest clinician after Hippocrates. From Harvey to Gaskell, Lewis and Mackenzie, English physicians have always excelled in the physiology and pathology of the circulation; from the tradition of Sydenham came

Willis, Heberden, Jenner, Parkinson, Bright, Addison, Hodgkin and many others who have been among the first to describe new or hitherto undecipherable diseases, who have noted the clinical minutiae which pass silently into our textbooks, and who have invented resourceful devices in therapy, including preventive vaccination and antiseptic surgery. If we bear in mind that Harvey started modern experimental physiology, Jenner preventive inoculation against disease (do not forget his initial observation of anaphylaxis), John Hunter experimental surgery, Lister antiseptic surgery, and that ether and chloroform anesthesia was introduced by Anglo-Saxon physicians in either hemisphere, then Osler's dictum will not seem exaggerated: "The modern history of the art of medicine could almost be written in its fulness from the records of the Anglo-Saxon race."

It is the principal glory of Linacre, however, to have established a great literary tradition in English medicine, a tradition of accurate, forceful and effective writing, and it is to this tradition that Helmholtz referred when he said that the English universities excel in training young men in athletic sports, in the standards of gentility and, above all, in the use of their mother tongue.

Thomas Linacre, founder of the Royal College of Physicians, physician to the King and to many other great personages, gave up a substantial practice to take holy orders, and so became "the restorer of learning in England," one of those who, in Osler's words, "sought to break the Arabian dominion and to restore to medicine the uncorrupted spirit of Greece." Linacre's Latin translations from the original MSS. of Galen, which he found in Italy, are the most important of those made by the medical humanists of the Renaissance; his books on accidence and grammar were widely used and frequently reprinted on the Continent. He taught Greek at Oxford, wrote Latin primers for the young princes who were his pupils, and his literary reputation is well conveyed in the enconium of Erasmus: "What can be more acute, more profound or more refined than the judgment of Linacre?"

The effect of Linacre's example is at once apparent in the literary style of Harvey, who wrote well, both in Latin and English. Harvey's English letters and private memoranda, edited by Weir Mitchell, make excellent reading, and the quality of his Latin may be sensed in any good English translation of his book on the circulation. His writings are never dull and formal, but the products of an exceedingly active mind and have the stimulating effect produced by "mind in motion." That he was very much alive, even when immersed in scientific investigation, is plain from the description of the Bass Rock, off the East Coast of Scotland, which occurs in his book on embryology:

> There is a small island which the Scots call the Bass Island (and speaking of this one will suffice for all), situated in the open ocean, not far from the shore, of the most abrupt and precipitous character, so that it rather resembles one huge rock or stone than an island, and indeed it is not more than a mile in circumference. The surface of this island in the months of May and June is almost completely covered with nests, eggs, and young birds, so that you can scarce find free footing anywhere; and then such is the density of the flight of the old birds above, that like a cloud they darken the sun and the sky; and such the screaming and din that you can scarce hear the voice of one who addresses you. If you turn your eyes below, and from your lofty stance and precipice regard the sea, there you perceive on all sides around an infinite variety of different kinds of sea-fowl swimming about in pursuit of their prey; the face of the ocean is very like that of a pool in the spring season, when it appears swarming with frogs; or to those sunny hills and cliffy mountains looked at from below, that are covered with numerous flocks of sheep and goats. If you sail round the island and look up, you see on every ledge and shelf, and recess, innumerable flocks of birds of almost every size and order; more numerous than the stars that appear in the unclouded moonless sky; and if you regard the flights that incessantly come and go you may imagine that it is a mighty swarm of bees you have before you. I should scarcely be credited did I name the revenue which was annually derived from the feathers, the eggs, and the old nests, which, as useful for firing, are all made objects of traffic by the proprietor; the sum he mentioned to me exceeds credibility. There was this particular feature which, as it refers to our subject, I shall mention, and also as it bears me out in my report of the multitudes of sea-fowl: the whole island appears of a brilliant white colour to those who approach it,—all the cliffs look as if they consisted of the whitest chalk; the true color of the rock, however, is dusky and black.

Of the other seventeenth century physicians, Sydenham and Willis wrote exclusively in Latin and are not specially remarkable for style. The Latin of Sydenham is, indeed, not easy to construe. The best of the eighteenth century physicians, Lettson, Fothergill, Young, Wells, Withering, William Hunter—were facile masters of the peculiar sober-sided literary manner, of precise and formal gait, which characterized the age of periwigs, three-cornered hats, ruffles, Geneva bands, brocaded coats, small clothes, buckled shoes and gold-headed canes. Of this periwigged, slightly pompous manner, Cadogan (in his essays on gout and infant hygiene) is the most exquisite example, while such active and effective sanitarians as Sir John Pringle, Charles White and Sir George Baker are more remarkable for native fire. Heberden wrote in Latin, Jenner was but an indifferent writer of English and John Hunter, original genius that he was, shows his distinct lack of early training in an occasional pathetic groping for expression which bears out the theory of psychologists that thought itself is a function of speech and will remain chaotic and formless until the thinker has become articulate through the exact use of words and language.

In the early nineteenth century, the literature of England was romantic in tendency, Sir Walter Scott, Byron, Coleridge, Blake, Shelley and Keats are its characteristic figures, and even Wordsworth was essentially romantic in his feeling for external nature. Something of this flavor of romance, of the feeling for strange lands and people, is apparent in the writings of John and Charles Bell, of Astley Cooper and in the large keepsake volumes devoted to the travels of Richard Bright (lower Hungary), John Bell (Italy), Thomas Hodgkin (Morocco), Patrick Russell (Aleppo) and William MacMichael (Constantinople), historian of the "Gold-Headed Cane." All the great physicians of Guy's Hospital (Bright, Addison, Hodgkin, Gull, Wilks) and of the Irish School (Stokes, Graves, Corrigan) were vigorous and effective writers. Sir Thomas Watson's treatise on practice (1843) was the acknowledged model of clear and informing literary style among the medical text books of its period.

In the second half of the nineteenth century, scientific medicine began to come into its own, and of this period Huxley is easily the topmost figure in respect of literary power and manner. Each of his sentences states a fact (a good model for all writers), no words are wasted, and the mental force behind these sentences has been likened by John Burroughs to that propelling and directing a javelin at a mark. The modest collection of aphorisms and reflections from Huxley's writings made by his widow in 1907 surpasses any other literary performance of Victorian physicians before the time of Osler and Allbutt. The writings of Darwin and Huxley have done most in the modern world to emphasize the supreme importance of scientific research, yet in this later Victorian period we find such charming books as Darwin's own travels (1860), the Horae Subsecivae (1858) of Dr. John Brown (of Rab and Marjory), Jeaffreson's "Book about Doctors" (1860), Wilks' and Bettany's History of Guy's Hospital (1892), the Medical History of Edward T. Withington (1894) and Richardson's "Disciples of Æsculapius" (1900).

English literary medicine in the twentieth century centers naturally about the work of the two Regius professors at Cambridge and Oxford. At the age of 85, Sir Clifford Allbutt, now in the plenitude of his powers, has given us the fine flower of his historical researches in "Greek Medicine in Rome" (1921), preceded by two other books of equal moment, on medieval science (1901) and on the historical relations of medicine and surgery (1905). These three books are distinguished by unrivaled knowledge, expert control of the basic sources and a literary style that is so pregnant with recondite allusion, so stimulating to thought, that one gains rather than loses on repeated reading. In "Greek Medicine in Rome" the subject is approached from a hundred different angles. No slightest fact of importance has been missed out in this wonderful book, which, to be appreciated, must be read when the mind is at its keenest. But if Allbutt writes in *oratio obliqua,* the indirection of the learned, Osler's writings are everywhere *oratio directa,* simple, direct, forward, the "literature of power," a source of inspiration to the struggling student and the overworked practitioner, and so well known to our profession that further comment is superfluous. At Oxford and in the Historical Section of the Royal Society of Medicine (organized Nov. 20, 1912), Osler gathered around him a remarkable pleiad of choice spirits—Norman Moore, D'Arcy Powell, Parkes Weber, Raymond Crawford, E. T. Withington, Charles and Dorothea Singer—and it is of the work of the latter that I desire, in conclusion, to speak.

Dr. Charles Singer, son of an English clergyman of scholarly reputation, was born at Camberwell in 1876, and after graduating in the arts from Magdalen College (Oxford), took his bachelor's degree in medicine at St. Mary's Hospital, London, in 1899 and his M.D. at Oxford in 1911. During the period preceding the European war, he held many hospital and laboratory appointments, diversified by periods of travel in Abyssinia, India, Egypt, Greece and Italy, study in Germany, and private practice in London and Oxford. His interest in medical history may be said to date from his marriage with Miss Dorothea Waley, granddaughter of the late Professor Waley of University College, London, a lady who has already done the best work to be credited to her sex in this field. Following the events of August, 1914, Dr. Singer was commissioned a captain in the Royal Army Medical Corps in November of that year, and served continuously through the war, mainly in the Levant. While on duty at Salonika, he acquired facility in modern Greek, which, in connection with previous work in the manuscript department of the British Museum, gave him (what is rare in physicians) the necessary equipment for the proper investigation of medical MSS in classical and Byzantine Greek, Latin and Anglo-Saxon. During the period of the war, his wife kept him supplied with photographic copies of medical MSS, with which he occupied what leisure he had while on military duty. After the peace, Dr. Singer was appointed lecturer on the history of the biological sciences at Oxford and in 1920, was appointed lecturer on the history of medicine at the same university. Soon after, he was appointed lecturer on the history of medicine at University College Hospital and, in connection with this work, moved up to London.

During his Oxford period, Dr. Singer was a household friend and intimate of Sir William Osler, in whose encouragement and influence he found his best inspiration.

At London, Dr. Singer has made his courses optional to students but open to outsiders on payment of a moderate fee. He finds these courses best attended by third year students, particularly those reading for honors in biology, and has arranged special courses for medical students about to graduate. Of the ten medical schools now competing with one another in London, University College is the only one which unites a medical faculty with a complete equipment in all the other faculties. It is in fact, a university, with some 3,000 students in arts, law, science and medicine. The departments of Egyptology (under Flinders Petrie) and of physiology (under Bayliss and Starling), are said to be the best in the world, while the faculty numbers such other eminent names as Elliott Smith in anatomy, W. P. Ker in English, Platt in Greek, Gollancz in Hebrew and Karl Pearson in eugenics and biometrics. These names alone will suggest that a university so progressive, so little hampered by conservatism, can do much for the teaching of the history of science by the mere interrelation of the different faculties. Dr. Singer does not believe in making these courses compulsory, except perhaps in relation to "pass tests." It is impossible to teach men to be investigators in science. Investigators are born, not made. The best that any teacher can do is to try out different men by putting them on suitable themes, with the proper outfit of reference books, success depending on whether the pupil has it in him to profit by the stimulus of personal contact with the professor. This was the method of Carl Ludwig, who turned out between two and three hundred eminent teachers and investigators of physiology, and of whom Heidenhain said (in this relation): "Ludwig is the only physiologist who ever did anything." It was, with some reservations, the method of Sir Michael Foster at Cambridge, of Osler at Johns Hopkins, of Finlayson at Glasgow, and it is the method of Sudhoff at the Institute of Medical History at Leipzig. This seminary method has been employed with success in this country by Dock at St. Louis, W. S. Miller at Madison (Wisconsin), Riesman at Philadelphia, and has recently been introduced at Harvard under Dr. Streeter and at Pittsburgh under Dr. Arthuthnot, Dean of the University of Pittsburgh School of Medicine. The main thing in all such courses is teaching the student how to do his own work, teaching him how to swim by throwing him into the water. "The difficulty of training a man as an investigator in medical history," Dr. Singer writes, "is of course the difficulty of his equipment. If a man comes to me who knows Arabic or Anglo-Saxon or Greek, or who has an experience among semicivilized peoples (any special equipment), I know what to do with him and can put him on something at once. But mere intelligence, is, in itself, hardly enough. I am conscious, however, that we have in this country neglected the fine field of modern medicine, and this would be the special field for the man of general intelligence." In his book on "The Future of Science," Ernest Renan argues that most writers of books on history of medicine lose their labor because they are not experts in Chinese, Arabic, Indian, and other ancient literatures. "Even supposing he knew Arabic, Chinese and Sanscrit well enough to write worthwhile monographs," he urges, "the whole life of the investigator would not suffice to make even a superficial survey of these vast and unexplored fields. It is sad to see a savant condemned to manufacture a history of Chinese medicine, merely to fill in a chapter of his book, and under the same conditions that one might write a history of Greek medicine from some faulty Arabic texts of the Middle Ages. That is why he is condemned to failure by the very table of contents (*cadre*) of his book."[1] The answer to this objection is that the best medical texts of antiquity have long since been exhumed and closely studied by experts; that investigation of ancient medicine has been of late years almost entirely in the hands of expert philologists, e. g. of Ebers and Lüring in Egyptian medicine, of Rohde, Diels, Wellmann, Ilberg and Rose in Greek and Roman medicine, of Steinschneider and Browne in Arabic medicine, of Jolly in Indian medicine, of Steinschneider and Preuss in Hebrew medicine, of Paul Haupt and the late Morris Jastrow in Assyro-Babylonian medicine; and that such excavations as those of Layard at Nineveh, Elliott Smith in Egypt, Evans in Crete, or such exhibits as that made by Sudhoff at Dresden in 1911, have taught us far more about the inwardness of ancient medicine than 90 per cent. of faulty manuscripts of uncertain value.

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[1] Renan, E.: L'Avenir de la Science, Paris, pp. 223-224.

The scientific and literary work of Dr. Singer comprises his medical papers, which deal mainly with diseases of the stomach and include laboratory investigations, his earlier historical papers, which are mainly devoted to histories of special subjects, e. g., contagion (1910-17), tobacco (1913), microscopy (1914-15), early treatment of gunshot wounds (1916); and his latest investigations, which are based on study of manuscript material and rise latterly into the larger atmosphere of interpretation. The fine flower of his recent work is to be found in the two volumes of "Studies on the History of Science," published at Oxford in 1917-21, and in four recent lectures and essays on Greek and medieval science (1920-21) which are based on these findings. The "Oxford Studies" consist of two large quarto volumes, made up of contributions by Singer, Withington, Crawford, and others, and more elaborately and beautifully illustrated than any other books of similar type. The two essays of Singer on St. Hildegarde and on the history of Greek science illustrate the recent trend of his work. In the first we are shown the workings of the medieval mind, as in Osborn Taylor's famous book, and realize that when the spirit of man is mainly set on the hope of heaven and the fear of hell, it is difficult to detach the mind and concentrate on objective scientific investigation, as Claude Bernard advised the scientist to do on entering a laboratory.

Supplementary to this chapter is the Oxford lecture on "English Magic and Medicine," which is most informing as to the many different elements which went to the making of medicine in the Dark Ages. Meanwhile, Mrs. Singer is at work on a reasoned catalogue of the 30,000 medieval MSS on science and medicine in England, and no less than 15,000 of these unprinted MSS are on medicine alone. Mrs. Singer's provisional classification affords some notion of what a medieval medical library was like, and how it might have been arranged. Singer's essay on the history of Greek biology, in the second volume of the "Oxford Studies," traces out in minute detail the remarkable work done by Aristotle and Theophrastus in descriptive natural history, and the effect of all this on medieval science. The beautiful full-page illustrations, mostly in colors, open up a new field in the showing up of the close observation of nature apparent on the Greek vases and in the drawings of plants by the medieval artists. The representations of the squid on Cretan and Mycenæan pottery, of the dentition of lions, of the arrangement of scales on deep sea fish, of the characteristic beak and claws of sea-eagles, on Ionian vases of the early period, are true and accurate as to identification of species, comparing favorably with the wonderful drawings of bison in the prehistoric caves, the Assyro-Babylonian lions or the miniature paintings of birds and plants in the illuminated missals and "Books of Hours of the Middle Ages." In Singer's view, Greek science died out utterly about 400 A.D., and modern science began with the books of Vesailus and Copernicus in 1453. The real advance made in science by the medieval peoples was along such practical trends as sanitation, military surgery, the invention of printing, of gunpowder, of the mariner's compass and of spectacle lenses. All else, even internal medicine, was descriptive science, and made no such gigantic strides as are apparent in the medicine of Hippocrates, the natural history of Aristotle or the botany of Theophrastus. I would strongly advise any physician to read these two essays in the "Oxford Studies," which give us new points of view and new insight into these matters, and which have a potent interest in that these studies were fostered and encouraged by Sir William Osler, whose life-work has been a source of inspiration to us all.

SECOND REPORT TO GOVERNORS OF THE INSTITUTE OF MEDICINE OF A COMMITTEE APPOINTED TO INQUIRE INTO THE QUESTION OF NECROPSIES IN THE HOSPITALS OF CHICAGO

Following the report of the committee for 1919,[1] the committee was continued and directed to report on necropsies in the hospitals of Chicago for the year 1920. The report is as follows:

Replies to a letter and questionnaire similar to that sent out for the year 1919 were received from 40 hospitals, each having a bed capacity of fifty or more. The capacity of the reporting hospitals for 1920 was 8,460 beds; there were 161,122 admissions and 8,135 deaths. Permission necropsies were made in 872 cases and coroner's necropsies in 329 others. The latter figure does not include coroner's necropsies at Cook County Hospital. Omitting Cook County Hospital, thirty-nine reporting hospitals had 4,868 deaths in which permission necropsies were made in 556 cases, 12 per cent., an increase of ninety-four, or 19 per cent. over 1919.

In twenty hospitals, the percentage of permission necropsies was larger in 1920 than in 1919. In some the increase was striking, as for example from 8 per cent. in 1919 to 41.3 per cent. in 1920, and from 7.1 per cent. in 1919 to 31.2 per cent. in 1920; whereas nine of the reporting hospitals held no necropsies in 1919, only six reported no necropsies in 1920.

In six hospitals the percentage of permission necropsies was over 20 (52.2, 41.3, 37.1, 35.4, 31.2, 20.1), in seven from 10 to 20 per cent.; in ten from 5 to 10 per cent., and in nine from 1 to 5 per cent.

While the reports indicate that there has been an encouraging increase in the number of permission necropsies, the percentage is still far below what it should be. In several hospitals the question of necropsies has received special consideration by the staff and pathologist, with a resulting increase in necropsies, and corresponding increase in interest by the staff in improving their professional work in the hospitals.

The resulting increase of permission necropsies in hospitals where an earnest effort has been made by pathologist and staff to obtain them has confirmed this committee in the opinion expressed in its report last year, that while prejudice and ignorance, together with religious scruples, account for much of the difficulty encountered in obtaining permission for necropsies, the alleged prejudice against necropsies is not so great as has been assumed, and that it is often advanced as an excuse when the real reason is indifference on the part of the staff, or lack of interest or incapacity on the part of the pathologist.

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[1] Proc. Inst. Med. of Chicago, 1920, 3, p. 150.

NECROPSIES IN CHICAGO HOSPITALS IN 1920

Name of Hospital	Beds	Patients	Deaths	Necropsies		Percentage Permission		Pathologist
				Permission	Coroner	1920	1919	
Alexian Brothers	285	3,300	270	20	40	7.4	4.9	Brother Surgius
American	125	5,000	69	2	5	2.9	12.1	J. R. Ledr
Durand	60	867	35	13	0	37.1	24.4	L. Hektoen
Augustana	200	3,935	218	10	0	4.5	3.7	A. Gallardo
Illinois Central	108	2,462	103	10	5	9.7	3.2	H. G. Wells
Chicago Fresh Air	104	282	73	5	0	6.8		
Chicago Lying-In	200	2,752	58	24	2	41.3	8.0	F. H. Falls
Chicago General	60	1,500	40	3	5	7.5		
Children's Memorial	175	2,492	222	78	..	35.4	23.1	W. G. Hibbs
Columbus Extension	75	1,578	43	3	17	6.9	....	S. Loyola
Columbus	150	3,658	52	3	13	5.7	....	C. O. Getty
Contagious Disease (municipal)	200	2,500	175	12	..	6.8		
Cook County	2,400	26,626	3,267	304	..	12.7*	8.9	F. Stangl
Frances Willard	120	3,526	81	2	5	2.4	0	
Garfield Park	60	1,500	40	0	0	0	0	W. French
German Evangelical Deaconess	68	2,300	70	0	4	0	2.0	W. H. Buhlig
Home for Destitute Crippled Children	111	996	5	..	..	0	0	
St. Anthony de Padua	200	4,236	233	3	58	1 2	4.7	F. B. Olentine
Isolation (smallpox)	50	181	1	0	0	0		
Mary Thompson	75	1,728	32	10	0	31.2	7 1	Katharine Howell
Lakeside	85	2,461	105	12	30	11.4	0	F. Hirschberg
Mercy	375	11,384	227	No definite record	12	....	13.0	
Michael Reese	459	9,093	365	41	..	10 9	9.0	O F. Schultz
North Chicago	85	2,019	51	3	1	5 8	?	Smith
Norwegian American	135	4,635	180	5	13	2 7	0	W. G Hibbs
Passavant	75	2,703	75	4	10	5.3	0	D. H. Ecke
People's	40	863	45	..	..	0	0	None
Post Graduate	85	......	56	No record	No record	....	....	E. G. Kirk
Presbyterian	425	9,300	287	150	5	52.2	48.4	B. O. Raulston
Ravenswood	42	1,536	51	10	2	19.6	13.6	J. J. Moore
St. Anne's	100	2,922	133	4	28	3.0	2.1	G. W. Wilson
St. Elizabeth's	225	4,621	247	4	21	1.6	....	L. Garness
St. Joseph's	166	4,662	199	36	5	18.1	21.4	W. H. Burmeister
St. Luke's	400	9,914	283	57	..	20.1	17.6	E. R. LeCount, Edwin Hirsch
St. Mary of Nazareth	200	4,957	282	2	14	0.7	....	J. B. Lusk
U. S. Marine	130	1,146	18	3	0	16.6	21.4	
University (West Side)	90	2.026	59	2	6	3.4	....	D. J. Royer
Washington Boulevard	85	2,595	57	4	2	7.0	8.2	H. K. Nicoll
Wesley Memorial	275	6,745	216	33	10	15.3	7.9	F. R. Zeit, J. P. Simonds
West Side	155	3,121	117	..	16	0	0	R. S. French

* Percentage of available material.

The following hospitals did not respond: Policlinic, Provident, Hahnemann, Henrotin Memorial, Park Avenue, St. Bernard, Washington Park.

The committee is further of the opinion that indifference in the matter of necropsies often goes hand in hand with professional indifference as to the correctness of diagnosis and treatment.

RECOMMENDATION: The committee recommends that further steps be taken by the INSTITUTE OF MEDICINE to stimulate the interest in necropsies in hospitals, by urging the consideration of the subject by hospital staffs, and that the results of this survey be made available to hospitals in Chicago.

D. J. DAVIS
A. B. KANAVEL
J. P. SIMONDS
A. FRICK
ERNEST E. IRONS, Chairman

ANNOUNCEMENTS

Graham Lusk, Pasteur lecturer in 1920, and Theobald Smith, Pasteur lecturer in 1921, have been elected honorary fellows of the Institute.

At the annual meeting of the Institute, Dec. 6, 1921, Frank Billings, A. L. Kendall and Theod. Tieken were elected governors for a period of five years.

At the annual meeting of the Board of Governors, December, 1921, Frank Billings was elected president for 1922; Thomas J. Watkins, vice president; E. E. Irons, secretary; J. A. Capps, treasurer; and L. Hektoen, chairman of the board.

Elected to membership in the Institute since the last issue: A. H. Parmelee, B. O. Raulston, Katharine M. Howell, F. C. Becht, L. H. Mayers, D. N. Eisendrath, O. F. Kampmeier, E. S. Ross, and Geo. Mosher.

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